HESBAN

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FAUNAL REMAINS:

TAPHONOMICAL AND ZOOARCHAEOLOGICAL STUDIES OF THE ANIMAL REMAINS FROM TELL HESBAN AND VICINITY

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HESBAN 13

ANDREWS UNIVERSITY PRESS BERRIEN SPRINGS, MICHIGAN

in cooperation with the
INSTITUTE OF ARCHAEOLOGY
ANDREWS UNIVERSITY

Published with the financial assistance of the
National Endowment for the Humanities
and Andrews University

Illustrations, unless otherwise noted, are from the Horn Archaeological Museum (Heshbon Expedition archive). Cover design by Ralph E. Hendrix. Series cover design by Peter Erhard. Figure 1.1 and Table 1.1 digitized by James Robertson. Dedication drawing and plate 1.9 courtesy of Sven Mathiasson, Naturhistoriska Museet, Goteborge, Sweden. Plates 1.12 and 2.2-36 courtesy of Øystein Sakala LaBianca. Figures 2.1, 3.2 4.2-7, 5.2-10, 5.17, 5.18 digitized by Sharon Prest. Plates 6.1-10, 7.1-7, 8.1-21, and 9.1-95 courtesy of the respective chapter authors. Figures 8.1-55 by Jennifer Johnson after various originals.

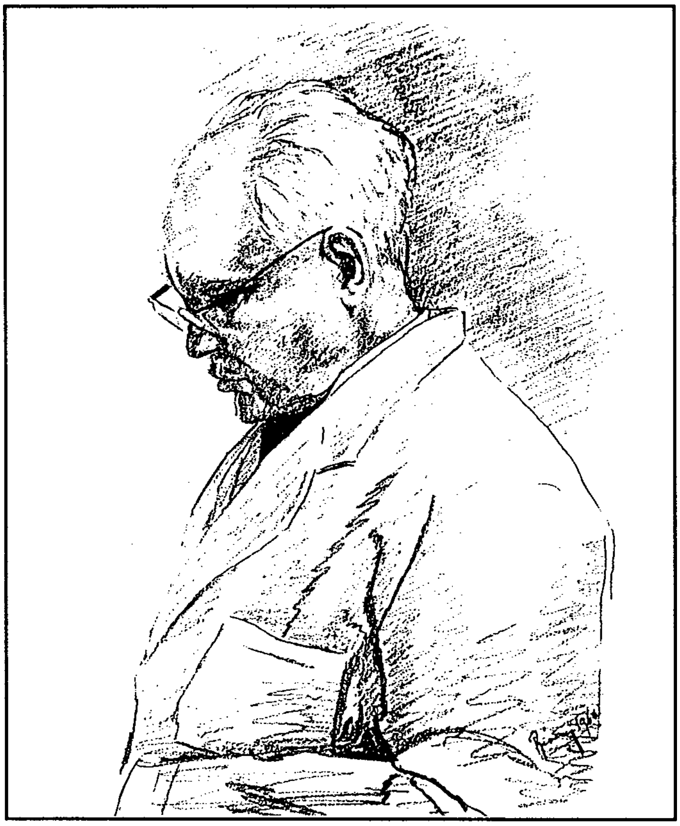
A joint publication of the
Institute of Archaeology
and Andrews University Press
Berrien Springs, Michigan 49104-1700
FAX: (616) 471-6224

Printed in the United States of America

99 98 97 96 95 5 4 3 2 1

ISBN 0-943872-29-4
Library of Congress catalog card number 95-77028

DEDICATION



Johannes Lepiksaar

Johannes Lepiksaar was born in Rakvere, Estonia, on the 20th of November in 1907. He was educated at the University of Tartu (Dorpat), Estonia, where he received his *Mag. scient.* in 1930. In 1968, he was awarded a PhD *honoris causa* at the University of Goteborg, Sweden, and later, at the University of Lund in 1988.

He was first appointed to the Department of Zoology at the University of Tartu in 1929 as an assistant curator. In 1939, he became curator of the Zoological Museum at the same university. During the troublesome years of World War II, Lepiksaar left Estonia for Sweden. He long refused to become a Swedish citizen—hoping for things to change in the east. Although he lost a great deal upon leaving Estonia (especially his library), being a man of principle and determination, he started over again upon arriving in Sweden. Over the years, his entire apartment was turned into a rich library! After some years in Uppsala, he was appointed to the Natural History Museum of Goteborg in 1949, where he was in office until he retired in 1972.

When Johannes Lepiksaar abruptly left Estonia, he was followed by his wife Niina, who never left his side and on whom he depended in every aspect of daily life. Niina was a former student of her husband. She was also a biologist and skilled watercolor painter. Their home was open to scientists from all parts of the world. Niina, born in 1911, died in Goteborg in December 1994.

Lepiksaar is an internationally-recognized vertebrate zoologist—specializing in osteology. His fields of research include domesticated animals, fish osteology, palaeozoology, and systematics. He has also been involved in faunistics and zoogeography—especially faunal history. Johannes Lepiksaar lives in Goteborg.

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Foreword

The collection and analysis of bones were part of the Heshbon Expedition's field methodology from the very first season in 1968. While concentrating mainly on human osteology, physical anthropologist Robert M. Little (1968-1971, 1976), also recovered animal bones and established a rudimentary system for data collection.

In keeping with the general revolution in archaeological methodology during the 1970s —emphasizing the important role of collateral sciences in archaeology (the so-called "New Archaeology")—specialists other than historians and archaeologists became more common at Tell Hesban. In 1971, geologist Reuben Bullard analyzed the Tell Hesban area (as did Harold James in 1974). Physical anthroplogist James Stirling participated in 1976.

It was during the second season in 1971, that Øystein LaBianca joined the project and volunteered to take responsibility for processing the faunal material, a job that would support his interest in what he would later term "food system" analysis. Understandably with an infusion of concentrated attention on food and food systems, the work of collecting animal remains became increasingly more sophisticated—including the establishment of a computerized database.

After several seasons, the more traditional historico-political questions about ancient Hesban basically were being answered (1968-1973) and the regional survey was taking shape (1973-1974). More dig resources were allocated to specialists. Of course, excavation on the tell and work on the regional survey continued through the 1976 season, but the persistence of Øystein LaBianca proved formidable.

The "bone work" (as it was then called) took on ever-larger dimensions with each season. "Bone reading" (comparable to sherd reading) began in 1973. The "Eco Lab" was more formally arranged that same year with both Øystein and Asta LaBianca as staff members. Øystein LaBianca continued the lab in 1974 with 3 assistants including Shirley Finneman, Douglas Fuller, Michael Toplyn.

The Eco Lab reached its zenith during the fifth season (1976) with specialists and staff numbering 25. In attendance were geologist P. Edgar Hare, paleobotanists Patricia Crawford and Robert Stewart, as well as zooarchaeologists Joachim Boessneck and Angela von den Driesch. LaBianca headed the lab, along with supervisor Patricia Tyner. Their 18 assistants included Esther Benton, Pamela Butterworth (artist), Mary Ann Casebolt, Robin Cox, Adelma Downing, Theresa Fuentes, Samir Ghishan, Elisabeth Horner, Asta LaBianca, Lori LaValley, Sissy May, Julia Middleton, Paul Perkins, Helen Shafer, Ralph Stirling, Merryanna Swartz, Michael Toplyn, and Paul Vance.

In 1976, as excavation began to wind down, attention turned to the final publication of results. The "Hesban Final Publication Series" was envisioned to span the entire breadth of the excavation, and the reports on the "faunal remains" were assigned to volume 13. A series of preliminary bone reports were presented with a flourish—largely in 1977 and 1978—always with the expectation that a more formal "final" report would soon follow. Final report manuscripts were completed and submitted to LaBianca between 1978 and 1981, but a number of different factors, including several personnel changes at the Institute of Archaeology, resulted in continual delays in actual publication.

The complications associated with publishing an extensive, 14-volume series (in terms of personnel, space, equipment, and funding) began to be realized. Teaching loads, academic pressures, and the establishment of new excavations at Tell el-ᶜUmeiri in 1984 ate away time and energy. Progress was extremely slow.

In the late 1980s, and particularly from 1988 to 1991, the immediate responsibility for pulling the faunal volume together rested with Lori Haynes in her role as managing editor of Hesban Publications here at the Institute of Archaaology. Bringing her experience with other volumes to bear, she, along with several student assistants, computerized the manuscripts and began working out problems—including those involved with translating over two-thirds of the volume from its original German (chapters 6 and 7 translated by Stephen Tobin), including many highly-detailed tables. She also worked with Jennifer Johnson to provide illustrations of the birds in chapter 8. It is Lori, more than any other individual, who can be congratulated for much of the underlying work on the volume. However, when she left the Institute in 1991, the remaining work had to be put temporarily on hold.

Meanwhile, LaBianca continued to be primary editor for his English chapters. Unfortunately, by this time Joachim Boessneck had passed away. Angela von den Driesch, however, kindly consented to become corresponding editor for the German chapters. (Her position was made all the more challenging by the fact that she had to deal with manuscripts written nearly 15 years earlier).

It was through von den Driesch's determined encouragement that attention was again directed to the volume in late 1993, with concentrated efforts beginning during the summer of 1994. By then, Ralph E. Hendrix had become director of archaeological publications. He therefore became managing editor for the faunal volume, taking up where Lori Haynes had left off. He set about bringing the volume to completion—a task which occupied him until now. In this task he was provided with valuable technical assistance from Stephanie C. Merling.

It is doubtlessly true that many individuals—other than those already named—directly contributed to this volume. Obviously, none of the original data would have been collected except for the foresight of Heshbon directors Siegfried H. Horn, Lawrence T. Geraty, and chief archaeologist Roger Boraas. Not so obvious may be the continual support of the Andrews University administration: first during the days of the Heshbon Expedition (president Richard Hammill), later during the early publication phase (president W. Richard Lesher), and now as the published research comes off the press (president Niels-Erik Andreasen). Their complete support and dedication to the task of archaeological research are tangibly attested by this volume.

So, as director of the Institute of Archaeology, it is with great pleasure that I witness the fruition of so many years of research and commitment as is found in this volume.

— Randall W. Younker, Director
Institute of Archaeology
Andrews University
Berrien Springs, Michigan
10 May 1995

Preface

The research which culminates with the publication of the present volume was begun in 1968 in connection with the first season of fieldwork by the Heshbon Expedition at Tell Hesban in Jordan. Credit for having made provision for someone to come along and work with the bone finds must therefore go to Siegfried H. Horn, who organized and directed the first three campaigns. Assigned to this work during the first campaign (1968) was Mr. Robert M. Little, then a part-time instructor in anthropology in the Department of Behavioral Sciences at Andrews University. Over the subsequent four campaigns (1971, 1973, 1974, 1976), the responsibility for the bone work fell on me, as Mr. Little—who had recruited me to assist him with the bones already in 1969—was unable to participate full time over these subsequent field seasons.

Upon inheriting the responsibility for the work with the animal bones in 1971—a mere first-year graduate student at the time—I soon found myself facing several challenges which have proven to be pivotal to the research on the animal bones from Tell Hesban. To begin with, there was the challenge of keeping up with the daily cleaning and labeling of the huge volume of bones which were uncovered each day. Then there was the challenge of learning on-the-job how to identify the different parts of the skeleton represented by each bone fragment, and—even more daunting—of providing some sort of preliminary species identifications for each fragment.

The greatest challenge of all, however, turned out to be having to defend and champion the bone work to fellow team members, many of them my superiors. After all, such work was not routine on digs elsewhere in Israel and Jordan at the time, and thus there were many who asked legitimate questions about why so much effort should be spent on collecting, cleaning, labeling and analyzing the animal remains. Although in some ways I relished this challenge of defending and championing the bone work, my youthful enthusiasm would have come to naught, I fear, had I not succeeded in rallying several internationally recognized experts to help out with the huge task of identifying, analyzing and reporting on the bone finds.

The first expert whose help I sought out was Professor Johannes Lepiksaar of the Museum of Natural History in Gothenborg, Sweden. His help consisted of identifying several hundred "rare" bones—especially the tiny bones of small mammals, birds, amphibians and fish—which I had culled out during my first field season in 1971 from the mass of fragments of common domestic species such as sheep, goat, cattle, horse and donkey bones. Thanks to his kind assistance, I was able to include in my preliminary report on the bone finds from the 1971 season an impressive list of wild fauna from Tell Hesban. I turned to Professor Lepiksaar again at the end of the 1976 season for assistance with analyzing the fish finds from all five seasons. He submitted the report in 1978 and it appears as chapter 9 in this volume.

While a special student at Harvard University in 1972-1973, I was introduced by Dr. Ruth Tringham (then an assistant professor in the Department of Anthropology) to the "new archaeology" debate within Anglo-American archaeology. Its call for better utilization of specialists by archaeologists, for more research on how the archaeological record is formed, and for a systems approach to integration of archaeological data provided me with much needed ammunition with which to go on championing not only the bone work at Tell Hesban, but also the related ethnoarchaeological and taphonomical research which we began during the 1973 season. Chapters 2 and 3 in this volume report on research which was inspired by Dr. Tringham's seminar on Archaeological Method and Theory.

While at Harvard, I was also able to make progress on another front, namely learning more about how to analyze the bones of domestic species. Thanks especially to instruction provided by Professor Barbara Lawrence of the Museum of

Comparative Zoology and Richard Meadow (then a graduate student in the Department of Anthropology), I was able to complete the research on the effect of post-depositional contexts on the preservation of sheep and goat bones which appears in this volume as chapter 4.

I am indebted to Richard Meadow and Melinda Zeder, the latter an undergraduate student at the time at the University of Michigan, for the opportunity to become acquainted with Professors Joachim Boessneck and Angela von den Driesch of the Institut für Palaeoanatomie, Domestikationsforshung und Gesschichte der Tiermedizin of the University of Munich.

The occasion which led to our becoming acquainted was a conference organized in 1975 by the above named students in connection with the Annual Meeting of the Society for American Archaeology. Entitled "Approaches to Faunal Analysis in the Middle East," the conference included a goodly number of North America's and Europe's leading experts in the field of zooarchaeology.

I had an advantage over many of my fellow North American participants at the conference in that I spoke several European languages, including German. This made getting to know a number of the participants easier for me, and I was particularly drawn to Dr. Boessneck because he seemed definitely to prefer speaking with those of us who spoke some German. He, in turn, introduced me to his colleague, Dr. von den Driesch (who also spoke good English), and, eventually, our conversation led to discussion of the possibility of their joining our team for the last campaign in order to carry out final analysis of the bone finds from all seasons.

The idea of cooperation between us became reality in the summer of 1976, when Drs. Boessneck and von den Driesch joined our team for four weeks in the end of July and early August. As I had hoped, their participation heightened even further the level of awareness and appreciation on our team of the importance of zooarchaeology to the overall goals of an expedition such as ours. During their brief but tremendously productive stay, they succeeded in identifying nearly all of the bones which had been saved over the past five seasons. With the help of a team of students, I saw to it that the information which they provided was recorded using specially prepared computer-oriented forms. A preliminary report on their analysis was first published in Andrews University Seminary Studies in connection with the report on the 1976 field season. Their final reports—which appear as chapters 5-8 in the present volume—were originally submitted to me over fifteen years ago.

That it has taken more than a decade for me to finally bring their and Professor Lepiksaar's manuscripts (chapter 9 below) to press is something for which I owe an explanation. Hence the following brief account of the circumstances which have contributed to this delay.

To begin with, there is the original idea behind this volume. The idea was that the volume should reflect the broad scope of our inquiries at Tell Hesban, including not only the results of laboratory analysis of the remains (chapters 5-9), but also the results of our fledgling ethnoarchaeological and taphonomical field studies of how the zooarchaeological record was formed (chapters 2-4).

Also central to the original idea of this volume was that it should be in English. My insistence on this was rooted both in the above-mentioned concern with promoting the study of animal bones in general and in my commitment to facilitate integration of the findings resulting from this line of specialized study into more broadly based attempts by myself and others to synthesize the data from Tell Hesban. A related concern, in this regard, was that the volume would be well illustrated, as I felt that this too would add to its appeal to an interdisciplinary audience of scholars and to interested members of the general public.

The reasons why it has taken this long to finally bring forth the present volume are several. They include my unwillingness to compromise on the above-mentioned requirements; difficulties in coming up with English translations of the manuscripts which were acceptable both to the authors involved and to our English editors; obstacles which had to be overcome in connection with our effort to secure funding and institutional support for an in-house publishing operation here at the Institute of Archaeology by means of which the entire 14-volume final report series could be prepared for printing; my inheriting primary responsibility for mounting new Institute-sponsored archaeological campaigns in Jordan in connection with the Madaba Plains Project; having to prioritize completion of my own dissertation above all other writing assignments (published as volume

1 in this series); and last but not least, the unabating demands of my duties as a student advisor, lecturer, departmental chair, and Institute of Archaeology staff member here at Andrews.

A consequence of this delay in publication is that the manuscripts being published here are not up-to-date as far as the most recent advances within the fields of ethnoarchaeology, taphonomy, zooarchaeology, historical zoogeography, and comparative anatomy are concerned. This situation is one for which I, as co-editor of the volume, take full responsibility. It is a lack for which my fellow authors should not be held accountable.

Beyond my indebtedness to the individuals already mentioned above, I am also indebted to a number of students, friends and other colleagues for having provided assistance with various aspects of the research which went into producing the present volume. Individuals who assisted with processing of the bone finds in the field include Nahla Abbouski, Glenn Bowen, Judy Chapman, Patricia Derbeck, Dick Dorsett, Avery Dick, Jennifer Groot, Elisabeth Horner, Asta S. LaBianca, Lori LaValley, John Lawlor, Rick Mannell, Tom Meyer, Julia Middleton, Eugenia Nitowski, Mohammad Said, Maryanna Swartz, Ralph Stirling, Hamat Tawfiq, and Michael Toplyn. I'm indebted to Asta S. LaBianca and Jennifer Higgens for help with punching the bone data into the computer. Special thanks go to James Perkins for assistance with computer programming and data processing. Translation services were provided by Irma Lidner and Stephen Tobin. Those who assisted in various ways with copyediting and preparation of illustrations include Lori Haynes, Jennifer Johnson, Cathryn Korsinowsky, Joan Milliken, Sandra Penley, and Ronald Russell.

For providing me with the opportunity to carry out this research, I am indebted to Professor Siegfried H. Horn, director of the first three campaigns, and Professor Lawrence T. Geraty, director of the last two. The latter was also particularly instrumental in making possible post-season analysis of the bone data following the 1976 campaign and in providing a place for me to continue my research and writing here at the Institute of Archaeology. I would also like to thank Professor Randall W. Younker, director of the Institute of Archaeology, and Mr. Ralph E. Hendrix, director of Archaeology Publications at the Institute, for their assistance with bringing out this volume.

— Øystein S. LaBianca
Andrews University
Berrien Springs, Michigan
10 May 1995

Chapter One

THE DEVELOPMENT OF THE BONE WORK ON THE HESHBON EXPEDITION

Øystein Sakala LaBianca

Chapter One

The Development of the Bone Work on the Heshbon Expedition

Introduction

Between 1968 and 1976, an estimated 100,000 bone fragments of animals were uncovered by the excavations at Tell Hesban. This site, which is located on the edge of the highland plateau (see map) overlooking the Jordan Valley and the Dead Sea approximately 20 km to the south of Amman, Jordan (see fig. 1.1 and pl. 1.1), has produced archaeological remains spanning more than three millennia, the earliest being the Late Bronze Age or *ca*. 1500-1200 B.C. (Sauer 1994). The purpose of this chapter is to describe the development of the study of animal bones at Tell Hesban and thus to inform both of the scope of the work and of its limitations.

Beginnings: The First Field Season

To properly evaluate the "bone work" which was undertaken by the Heshbon Expedition—this is what the project was called since its foremost mission, as far as its sponsors were concerned, was to ascertain whether Tell Hesban might have been the biblical town of Heshbon (*cf.* Horn 1982)—something must be said about the state of the study of animal bones from archaeological sites in the late-1960s in Palestine when the project was started. What is particularly important to note is the state of studies of animal bones from historical—as opposed to prehistorical—sites.

In Palestine, as elsewhere throughout the ancient Near East, the study of animal bones from

Figure 1.1 Map of Palestine showing the location of the Tell Hesban Project area.

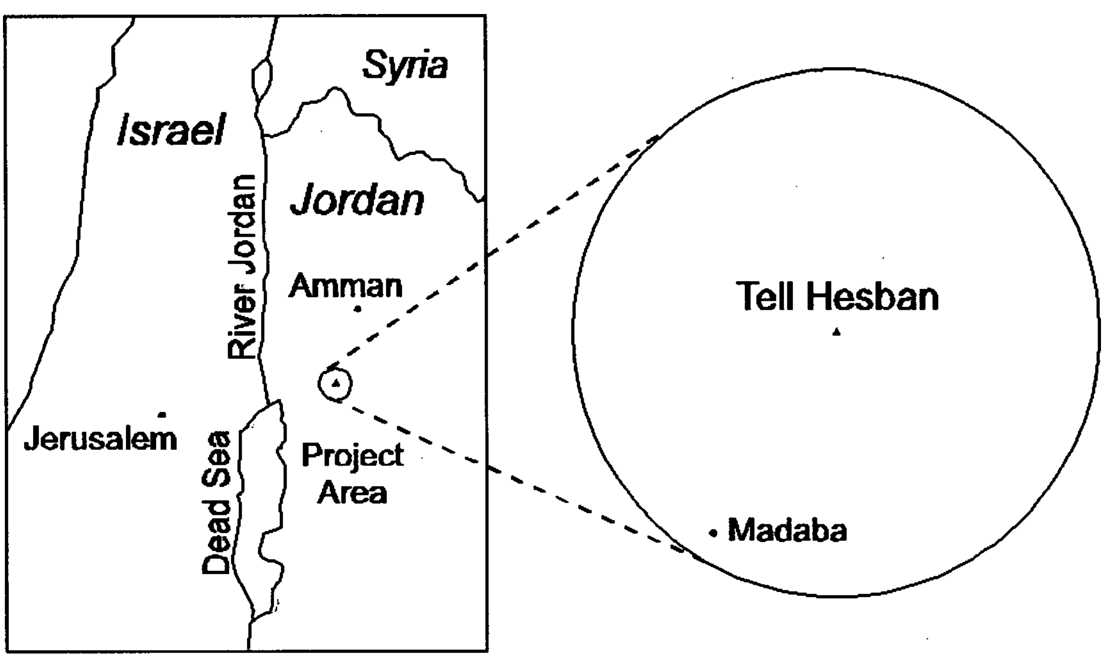


Plate 1.1 Tell Hesban as seen from the air.

prehistoric sites was well underway already by the time of the beginning of the Heshbon Expedition (*cf.* Dyson 1953; Angress and Reed 1962). The reason why is clear: animal bones were deemed essential to answering questions about the origin of domestication and the beginnings of agriculture in the Old World. They were thus being collected with much the same care as were human artifacts.

It is when we enter historical times that the study of animal bones suddenly is almost nowhere to be found in Syro-Palestinian archaeology at this time. Again the reason is clear: the concerns of prehistoric anthropologists with the history of domestication and beginnings of farming obviously failed to provide a compelling rationale for why the thousands of domestic animal bones which were routinely unearthed by archaeologists working at historical sites in Palestine should be collected and analyzed. To this absence of a compelling rationale must be added the fact that most archaeologists working in Palestine during the first half of the 20th century were trained either as classical or biblical archaeologists and not as anthropologists. Their concerns were with seeking answers to historical questions and with searching for artifacts, inscriptions, and architectural remains which could illuminate the world of the ancient Greeks and Romans, and in the case of biblical archaeologists, the world of the ancient Israelites and their neighbors. In the minds of most of these scholars, there was very little or nothing which the study of animal bones could yield which accorded with their research agendas. Consequently, most of them simply tossed the bones away.

Siegfried Horn's grasp of developments outside of his own immediate discipline of biblical archaeology is attested by the fact that he made provision for an anthropologist to join his expedition from the very beginning. He was determined, it seems, that his expedition would utilize the most advanced techniques available. In this vision he was

Plate 1.2 Robert Little.

also supported by chief archaeologist Roger Boraas. It is thus to their credit that the decision was made not to toss, but rather to systematically collect and record, animal bones along with pottery and other artifacts uncovered during the first season of fieldwork in 1968. The individual whom Siegfried Horn turned to for assistance with studying the bones was Robert M. Little, then a graduate student in physical anthropology at Indiana University (pl. 1.2).

During that first field season, Little set up the basic procedure for collecting and cleaning animal bones. It consisted of bone fragments being collected by square supervisors and their workmen simultaneously with pottery pieces. Whereas pottery was deposited in pottery pails, bone fragments were placed in paper bags which carried the same identification tags as the pottery pails they accompanied (pl. 1.3). Only when articulated skeletal material was encountered was the anthropologist called to the scene to assist with excavation of bone material (Little 1969: 234).

Plate 1.3 Workman placing an animal bone in a paper bag.

The rate at which animal bones began to accumulate using this procedure necessitated that priorities be set already during the first field season as to which bones would be "saved" and "registered" for future study. Thus, it was decided that priority should be given to three categories of bones: one, those "that seemed to be of special interest because of shape, size, color, or rarity;" two, those found in "sealed" loci; and three, "all bone fragments from Area B" because of the anticipated importance of this probe as a baseline for establishing "the stratigraphic sequences for the entire tell." Furthermore, "all unidentifiable fragments, and of disarticulated material, all ribs and long bone fragments that were not part of proximal and distal ends" were discarded (Little 1969: 233, 234).

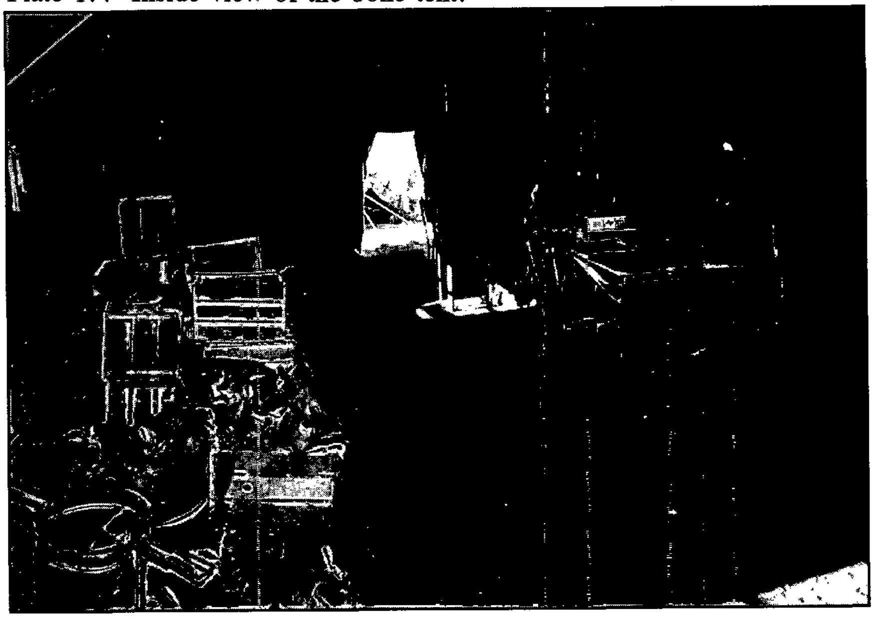
Not surprisingly, perhaps, Little's impressions following preliminary analysis of 6,682 registered bones from the first season was that the "great majority" of them represented "food consumed by the population which resided at the site." Especially plentiful throughout all periods were the bones of sheep and goats. Bones of chicken and fish were also well represented. The appearance of pig bones in the layers dated to the Christian Era at Hesban, however, pointed to changes over time in patterns of meat consumption (Little 1969: 238).

These preliminary findings following the first season of fieldwork were important to the future of the study of animal bones from Tell Hesban. They served to establish the potential of such study sufficiently to make the collection of animal bones an on-going undertaking of the Heshbon Expedition during all subsequent field seasons.

Development: The Second through Fourth Field Seasons

The work begun by Robert Little was continued by myself and several assistants during the remaining four field seasons of the Heshbon Expedition. As a number of personal matters made it impossible for Little to return to the field full time, he had recommended to Siegfried Horn that I be invited to go along and carry on with the bone work in his absence. This invitation came about as

Plate 1.4 Inside view of the bone tent.



a result of my having taken "Introduction to Anthropology" from him. Much of what follows, therefore, is autobiographical in nature—an account of my own thoughts and activities as they contributed to the development of the bone work on the Heshbon Expedition.

My preparation for the field consisted primarily in having assisted Little (in connection with a lab requirement for "Introduction to Anthropology") in cleaning and registering several hundred bags of bones which he had shipped to the US at the end of the first season. A high-point of this lab experience was being invited by Little to accompany him to the University of Michigan, where we had occasion to discuss our work with Kent Flannery. In addition to showing us around his own lab and telling us about his work, Flannery directed us to several helpful publications, including a recent article in the British journal *Antiquity* by Raymond E. Chaplin (1965) entitled "Animals in Archaeology."

After being officially invited to join the Heshbon Expedition by Siegfried Horn in January, 1970, I began searching in the James White Library at Andrews University—where I was a senior in the undergraduate college—for more articles and books on the subject of faunal analysis. I came across several helpful items, including an article by Robert H. Dyson (1953) in *American Anthropologist* entitled "Archaeology and the Domestication of Animals in the Old World." Particularly helpful was an article by Shimon Angress (1959) reporting on 200 remains of mostly domestic mammals from Beersheba in Israel (Angress 1959). Bodenheimer's book *Animal Life in Palestine* (1935) provided a most helpful overview of the present-day wildlife of the region.

Armed with these and several other articles and books, along with my experience in Little's lab, I looked forward to joining the team in Jordan for its second field season in 1970. The anticipation turned to disappointment, however, as word reached us in Turkey that the expedition had been cancelled due to the fighting between Palestinian commandos and the Jordanian army in the region where we would be working. I made a hasty change of plans and ended up spending that summer in Europe studying French instead!

A successful second season was mounted the following summer, however, and—thanks to a three-month deferment of my national service obligation kindly provided by the US Government—I was excited to be among the participants. I had looked forward to the challenge of being the expedition's "bone man" and felt I had done what I could to prepare for the job. After some initial scrambling for supplies and a place to set up a work-table at headquarters, I was ready to go to work.

I realized quickly, however, that if I was going to be able to keep up with the bone processing work, I had to work all day at it—even if it meant giving up digging in the tombs in the mornings. To this end, a "bone tent" was put up near the summit of the tell (pl. 1.4). Instead of bone bags being brought to headquarters, they were henceforth brought by each square supervisor to the bone tent at the end of each work day. Here they would be left overnight and be ready for processing the next morning (pl. 1.5).

The processing which took place in the bone tent consisted primarily of separating bones to be saved from those that would be discarded and cleaning and labeling of saved bones (pl. 1.6). The only bones that were not saved were the splinters of long-bones, vertebrae and ribs which had no articulating surface or other features by means of which they could be identified. All other bones were saved, cleaned by means of dry-brushing and labeled as to find spot (pl. 1.7). In other words, the other selection criteria put into action during the previous season were discontinued.

Plate 1.5 Øystein and Asta LaBianca with Mohammad Said cleaning bones.

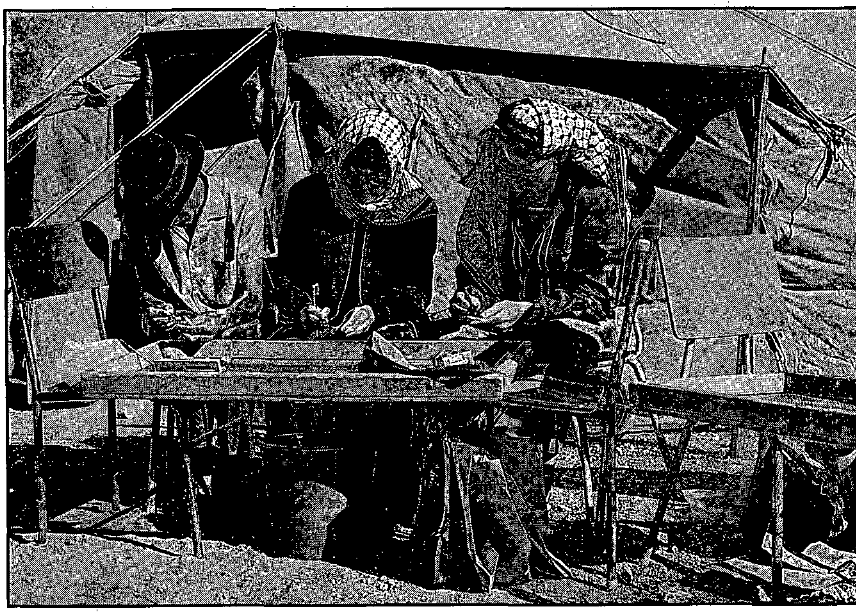
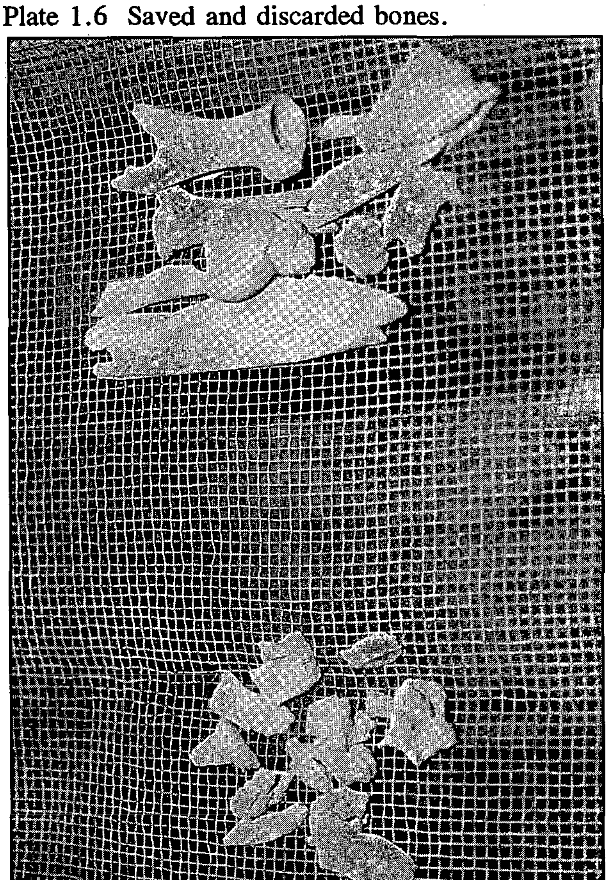


Plate 1.6 Saved and discarded bones.



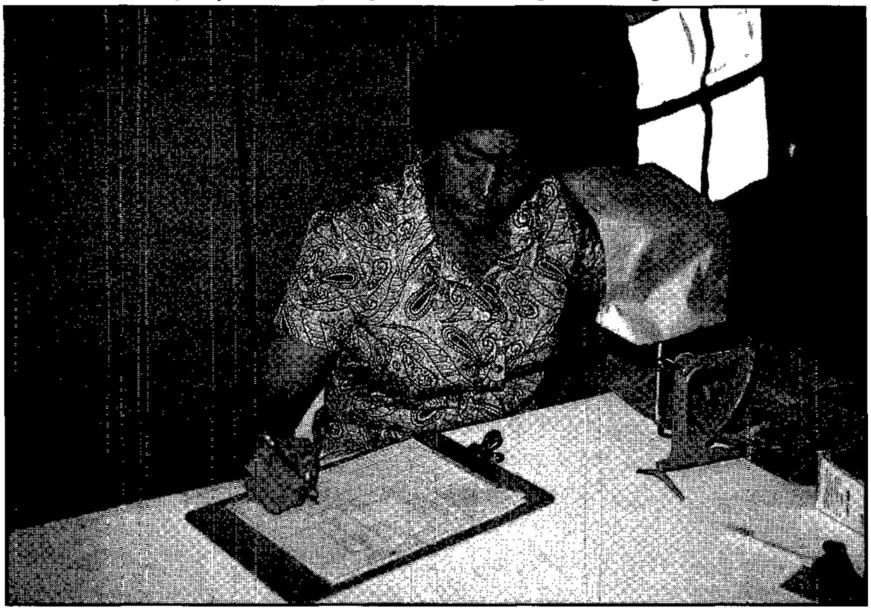
Bones which had been cleaned and labeled during the morning were transported to headquarters in the early afternoon. At headquarters, processing began by sorting the bones into categories according to skeletal parts and species (as had been done during the previous season by Little). See pl. 1.8.

For a novice such as myself, this was a useful approach, because it soon brought to light patterns which helped me and my assistants to become acquainted with the distinctive features of the dominant species, namely: sheep, goats, cattle, donkey, horse, camel, pigs, and chicken. Bones whose features were notably different from these dominant species were put aside for special treatment. All small mammal, bird, reptile and fish bones were thus set aside.

Separation into species was followed by recording of each identified bone fragment. Such information as find spot, species type, skeletal part, and position (left or right, proximal or distal) was recorded, as were signs of burning and butchering marks on the bones. By the end of the 1971 campaign, 5,867 bones were registered.

Johannes Lepiksaar of the Museum of Natural History in Gothenburg, Sweden helped identify the suitcase full of "rare" small mammal, bird, reptile and fish bones which we had accumulated by the

Plate 1.7 Patsy Tyner weighing and recording bone bags.



my spare time, I worked on designing a system for encoding the bone data and on keypunching it into the computer. The resulting printouts of bones sorted according to species and find spot (table 1.1) provided the basis for my first report dealing with animal bones from Tell Hesban (LaBianca 1973).

Feeling the need for additional mentoring in the field of zooarchaeology, I ended up contacting Barbara Lawrence of the Museum of Comparative Zoology at Harvard University to see about the possibility of continuing my training there. She encouraged me to apply through the Department of Anthropology to come and spend a year as a special student working with one of her mentees, Richard Meadow. This I did, and thus ended up serving the second year of my national service obligation working full-time at the Harvard's Peabody Museum Library while continuing my training in zooarchaeology as a part-time student in the Department of Anthropology.

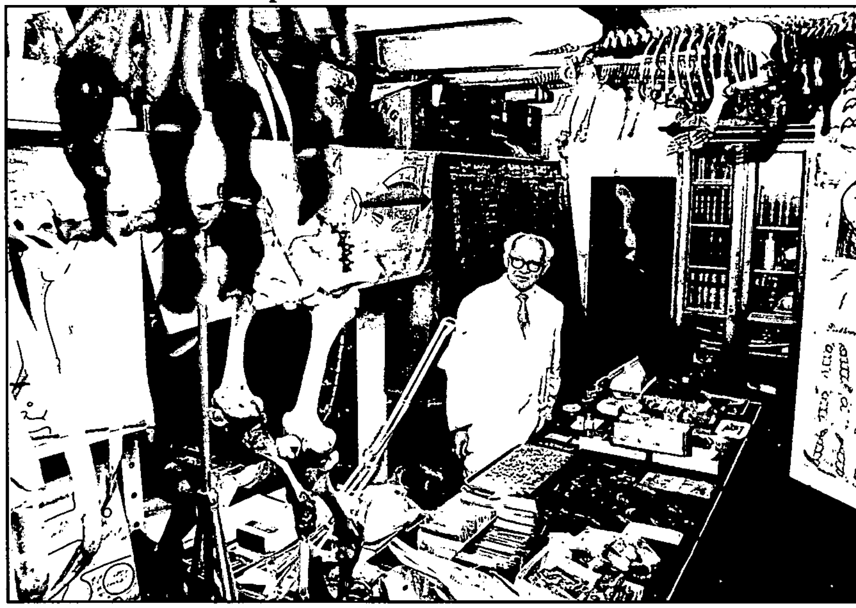
end of the 1971 field season (Pl. 1.9). I was referred to him by personnel at the Museum of Natural History in Oslo, Norway whom I had approached for help during a stop-over there.

Among the most vivid impression of my visit with Lepiksaar and his wife, Nina, was the generous hospitality of this gracious Estonian couple: the neat little apartment which included a room filled with reprints and correspondence neatly organized and shelved, and the "bone cellar" at the Museum, where Lepiksaar worked as a curator. Here I could observe first-hand how an expert in the field of zooarchaeology went about identifying animal bones using a comparative collection. Lepiksaar's rigorously systematic approach, and the pride he took in his work, left an indelible impression on me as a young man.

On returning to the United States, I ended up in Southern California where I was to begin two years of national service working at Loma Linda University Medical Center. In

Plate 1.8 Bones sorted by part.

Plate 1.9 Johannes Lepiksaar.



Under the tutelage of Lawrence and Meadow, I embarked on a more in-depth analysis of the bone finds from the 1971 season at Tell Hesban. I was particularly interested in the effect of archaeological context on recovery rates of different types of bones. I also wanted to learn more about the role of local environmental factors in determining the types of species which were encountered in the archaeological record. A portion of this previously unpublished research is included in chapter 3 in this volume.

Through the Department of Anthropology I also was introduced to the "new archaeology" movement in Anglo-American archaeology, thanks to a graduate seminar in archaeological method and theory led by Ruth Tringham. The readings and discussions which I was exposed to in this seminar had a profound influence on me, especially the calls for better utilization of specialists and for systematic study of how the archaeological record was formed. These calls resonated deeply within me as I had been struck already in 1971 by the fact that the ubiquitous sheep and goats grazing on the slopes surrounding present-day Hesban were no doubt there because of the persistence of the same cultural practices that

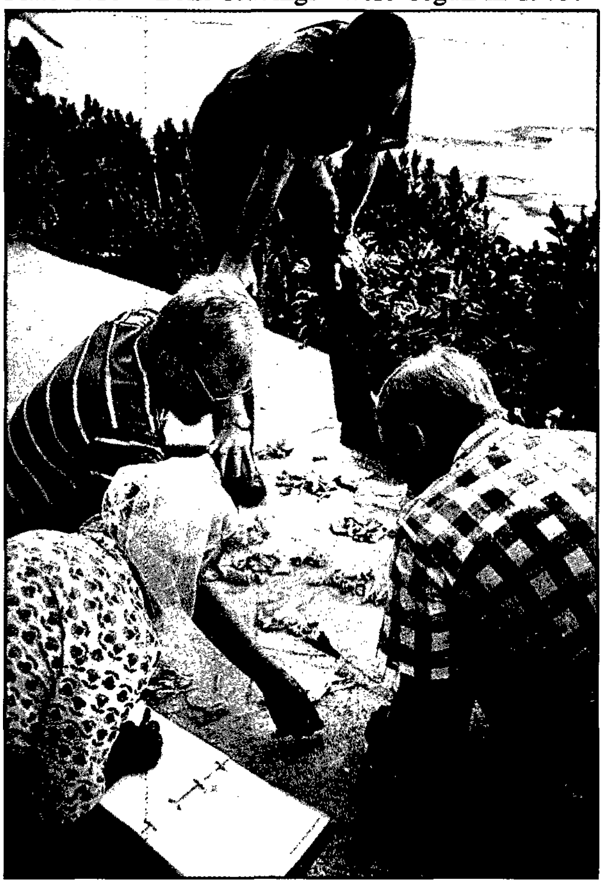
Table 1.1 Computer-generated printout of bone data.

ALL BONES ACCORDING TO LOCATION

KEYS 1
MATCH 2

DIG	AS	USK	LOC	NR	KIND OF ANIMAL	KIND OF BONE	MAXWI	W	M	MAXLE	CHARACTERISTICS LRPRXDISCHRACHPITCCMSMLNEPYNGMEDLRGEPO
H71	B3	5	2	6	CANIS LUPUS F FAMILIARIS	METACARPAL	.00	.00	.00	.00	EPO
H71	B3	7	4	2	CAPRA HIRCUS OR OVIS ARIES	RADIUS	.00	.00	.00	.00	DIS NEP
H71	B3	20	5	2	CAPRA HIRCUS OR OVIS ARIES	METACARPAL	.00	.00	.00	.00	RPRX
H71	B3	3	5	5	CAPRA HIRCUS OR OVIS ARIES	INNOMINATE BONE	.00	.00	.00	.00	
H71	B3	37	13	1	EQUUS AFRICANUS F ASINUS	UD BONE	.00	.00	.00	.00	
H71	B3	31	13	1	GALLUS GALLUS F DOMETICUS	FEMUR	.00	.00	.00	.00	
H71	B3	35	16	1	BOS PRIMIGENIUS F TAURUS	PHALANGE I	28.00	.00	.00	66.00	
H71	B3	35	16	1	BOS PRIMIGENIUS F TAURUS	PHALANGE I	28.00	.00	.00	66.00	
H71	B3	56	21	1	BOS PRIMIGENIUS F TAURUS	METAPODIAL	57.60	22.00	29.60	.00	DIS GCH
H71	B3	26	21	11	BOS PRIMIGENIUS F TAURUS	PHALANGE II	26.00	.00	.00	36.00	
H71	B3	56	21	7	CAPRA HIRCUS OR OVIS ARIES	MANDIBLE	.00	.00	.00	.00	
H71	B3	56	21	2	CAPRA HIRCUS OR OVIS ARIES	METACARPAL	.00	.00	.00	.00	L PRX
H71	B3	56	21	15	GALLUS GALLUS F DOMETICUS	HUMERUS	.00	.00	.00	.00	
H71	B3	50	25	1	CAPRA HIRCUS OR OVIS ARIES	METACARPAL	.00	.00	.00	.00	PRX
H71	B3	54	26	1	BOS PRIMIGENIUS F TAURUS	PHALANGE II	28.00	.00	.00	41.00	
H71	B3	51	26	1	CAPRA HIRCUS OR OVIS ARIES	MANDIBLE	.00	.00	.00	.00	L
H71	B3	51	26	3	CAPRA HIRCUS OR OVIS ARIES	METATARSAL	.00	.00	.00	.00	L PRX
H71	B3	52	27	1	BOS PRIMIGENIUS F TAURUS	METAPODIAL	59.30	35.50	23.00	.00	DIS PIT
H71	B3	57	27	1	BOS PRIMIGENIUS F TAURUS	METAPODIAL	.00	.00	.00	.00	DIS
H71	B3	52	27	3	CAPRA HIRCUS OR OVIS ARIES	MANDIBLE	.00	.00	.00	.00	R
H71	B3	52	27	0	CAPRA HIRCUS OR OVIS ARIES	MANDIBLE	.00	.00	.00	.00	L
H71	B3	53	27	6	CAPRA HIRCUS OR OVIS ARIES	MANDIBLE	.00	.00	.00	.00	R
H71	B3	57	27	2	CAPRA HIRCUS OR OVIS ARIES	MANDIBLE	.00	.00	.00	.00	L
H71	B3	57	27	3	SUS SCROFA F DOMESTICA	MAXILLA	.00	.00	.00	.00	
H71	B3	76	33	1	BOS PRIMIGENIUS F TAURUS	METAPODIAL	44.00	.00	.00	.00	
H71	B3	76	33	3	GALLUS GALLUS F DOMETICUS	ULNA	.00	.00	.00	.00	
H71	B3	77	39	2	CAPRA HIRCUS OR OVIS ARIES	TIBIA	.00	.00	.00	.00	L PRX
H71	B3	77	39	8	CAPRA HIRCUS OR OVIS ARIES	METACARPAL	.00	.00	.00	.00	L DIS NEPYNG
H71	B3	77	39	9	CAPRA HIRCUS OR OVIS ARIES	SCAPULA	.00	.00	.00	.00	L
H71	B3	82	46	3	BOS PRIMIGENIUS F TAURUS	PHALANGE II	27.00	.00	.00	39.00	
H71	B3	82	46	4	CAPRA HIRCUS OR OVIS ARIES	PHALANGE II	.00	.00	.00	.00	
H71	B3	82	46	5	CAPRA HIRCUS OR OVIS ARIES	TIBIA	.00	.00	.00	.00	L DIS EPO

Plate 1.10 "Bone readings" were begun in 1973.



produced the large quantity of sheep and goat bones during earlier centuries. In the new archaeology, I found the rationale I needed to broaden the bone work to include investigations of the natural environment and the present-day population of Hesban. I resolved to attempt to do so upon my return to Jordan in the future.

Upon returning to Jordan in 1973, I began immediately to follow through on this new agenda. In addition to continuing the daily processing of the animal bones in the bone tent and in the lab, several new procedures were introduced, all of them intended as means to learn more about how the zooarchaeological record at Hesban had been, and continued to be formed.

To begin with, daily "bone readings" were introduced (pl. 1.10) whereby I reported to each square supervisor about the bones found in their squares in return for their telling me about the nature of the deposits from which their bone samples had been recovered. We also began a taphonomic survey in and around the present-day village of Hesban (see chapter 2). The purpose of this survey, was to discover the extent to which the bones which could be found lying on the ground were representative in some way of the living population of domestic animals belonging to the present-day villagers. This, in turn, led to our first ethnoarchaeological inquiries, which focused on butchering and meat preparation practices in the village in order to learn more about which parts of the carcass of food animals are most likely to end up as a part of the zooarchaeological record. Preliminary results of these investigations, along with their relevance for interpreting the more then 7,000 animal bones registered that season, were the subject of our 1973 season's report (LaBianca and LaBianca 1975). A more extensive report is included in chapter 2 in this volume.

The fledgling inquiries begun during the 1973 season were significantly expanded during the 1974 season, thanks especially to the enthusiastic support of Lawrence T. Geraty, Siegfried Horn's successor as director of the Heshbon Expedition. There were obviously no doubts in his mind as to the importance and relevance of the sorts of inquiries I had begun. On the contrary, he was eager to see them continued and expanded. As he once put it to me in planning for the season, "the sky is the limit."

Thanks, then, to such generous support, several volunteers were made available to me to assist with the daily routines in the bone tent (Glenn Bowen), and bone lab (Michael Toplyn and Ralph Stirling), as well as with the work in the village (Michael Fuller and Shirley Finneman). See pl. 1.11. My wife, Asta Sakala LaBianca (who had assisted me in 1974), was also on hand to help in both the lab and in the village.

A total of 11,006 animal bones were cleaned and registered by the end of the 1974 season. A large number of these came from a single Early Roman cistern and served as the basis for our bone report for the season (LaBianca and LaBianca 1976). A separate report dealing with the mollusca from the 1971, 1973, and 1974 seasons was prepared post-season by Patricia Crawford (1976).

The 1974 field season included several additional lines of inquiry as well, all of them judged to be important in some way to understanding the broader environmental and cultural context in which animal husbandry practices had developed in the past in this region. These included studies of the geology of the Hesban region (James 1976); studies of the present-day wild plants of Hesban and vicinity (Crawford and LaBianca 1976); studies of ancient carbonized seeds collected in the excavations on the tell and separated out by means of froth flotation (Crawford, LaBianca, and Stewart 1976); studies of the human skeletal remains from a nearby Roman-Byzantine cemetery at Hesban (Stirling 1976) and studies of the present-day inhabitants of the village of Hesban (LaBianca 1976).

Plate 1.11 Mike Toplyn and Pam Butterworth assisting in the bone lab.

Plate 1.12 J. Boessneck and A. von den Driesch analyzing bones.

The Climax: The Fifth Field Season in 1976

The various lines of ethnoarchaeological, environmental, taphonomical and zooarchaeological research begun during previous seasons of fieldwork culminated in the fifth (and final) season of the Heshbon Expedition in 1976. Not only were there more volunteers assigned to help with these various investigations, additional specialists were on hand as well (Alomia 1978; LaBianca 1978). Of particular importance to the culmination of the bone work was the participation of Joachim Boessneck and Angela von den Driesch (pl. 1.12) of the Institute für Palaeoanatomie, Domestikationsforshung und Geschichte der Tiermedizin of the University of Munich.

To expedite their work, a special post-season bone lab was set up at the Seventh-day Adventist School in Amman which provided ample space for these two specialists to work, and for myself and half a dozen student assistants to work as well. Over a period of about four weeks, Boessneck and von den Driesch succeeded in examining every bone saved over the five seasons of excavation—approximately 20,000 fragments. In the process they culled all bones of wild or rare species that had escaped notice by myself during previous sortings. They also measured every fragment that was complete enough to allow calliper readings to be taken (Boessneck and von den Driesch 1978).

Quantitative data by means of which the relative abundance of various skeletal parts and species could be estimated was only collected for the bones from the 1976 season. The reason for this was that, unlike during the 1976 season when every fragment was saved (by request of Boessneck and von den Driesch), the bones unearthed during previous campaigns had not all been saved (as noted earlier). What in my judgment had been too fragmentary to identify—in other words, all the scrap—had only been counted, then discarded. Such scrap, it turned out, could also be identified and was needed in order to obtain accurate quantitative data—especially weight data—on the relative abundance of different species of animals.

The information generated by Boessneck and von den Driesch on the bones from the 1976 season was recorded on specially-designed computer-oriented data forms by a team of student assistants. Upon my return to the US, I arranged for the data to be key-punched so it could be processed using the computer. As I needed to be able to assign the bone data to particular strati-graphical contexts, I suggested to Geraty that we design a computer-oriented recording system by means of which the cumulated stratigraphic inform-ation from Tell Hesban could be summarized.

Upon offering to assist with getting this initiative underway, my suggestion was readily agreed to, and—thanks to much work on developing the forms by Larry Mitchel and James Brower (and to heroic data entry marathons by Bert de Vries, Mitchel and Bjornar Storfjell)—the large quantity of stratigraphic information collected over all five seasons at Tell Hesban was computerized. Once all the data had been entered, the bone data could be sorted according to periods—and in innumerous other ways—and printouts were generated which were sent to my colleagues in Munich for their use in preparing their final reports.

A Challenge of Integration: The Final Publication Project

The broadening of the scope of research to include investigations not only of the animal bones themselves, but also studies of depositional processes and present-day cultural practices related to the exploitation of animals led, in the end, to a dilemma—how to integrate the many disparate lines of research (LaBianca 1978; 1986). Not only was this a challenge as far as the bone work was concerned, it was a challenge which confronted the entire project by the end of the fifth and final season (LaBianca 1990).

The dimensions of this challenge were numerous: how to get excavators to share archaeological context information with various specialists; how to get the specialists to provide succinct reports on their work which could be used by the excavators in interpreting their strata; how best to facilitate post-season communication between excavators and specialists once they returned to their homes throughout North America and Europe; how to fit together data from many different periods produced by many different lines of research; how to communicate effectively across the disciplines; how to organize the presentation of the final results.

To deal with this challenge, several lines of attack were planned and carried out. First, as mentioned earlier, computerization of all excavation records from the five seasons of fieldwork was undertaken. Second, a National Endowment for the Humanities grant was sought and received which facilitated post-season travel by various investigators to a series of conferences at which progress on final data analysis was shared and critiqued. Third, out of these conferences emerged the plans for the organization of Hesban Final Report Series. Co-editors of the series would be Lawrence T. Geraty and myself. Fourth, an editorial office was established at the Institute of Archaeology at Andrews University which would be responsible for preparing camera-ready copy of the final reports as they were produced. And fifth, a program of research (carried out in connection with my doctoral studies at Brandeis University) was initiated with the explicit goal of coming up with an integrative conceptual framework for use in interpreting the disparate finds from Tell Hesban. This led to the development of the food system perspective, which has been set forth in volume one of the Hesban series (LaBianca 1990).

Overview of Volume 13

The reports which have been assembled in the present volume represent two complementary lines of research emerging from the bone work of the Heshbon Expedition. On the one hand are chapters 2-4 which reflect my own concern with the cultural practices and depositional processes which account for the composition of the zooarchaeological record at Tell Hesban. On the other hand are chapters 5-9, authored by my European colleagues Joachim Boessneck†, Angela von den Driesch, and Johannes Lepiksaar, which present—from the perspective of comparative osteology and zoogeography—the results of their analysis of animal remains produced by the excavations. Chapter 10 sets forth the implications of the findings reported in the previous chapters for understanding the dynamics of Tell Hesban's archaeological record and the food system of its inhabitants.

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Chapter Two

ETHNOARCHAEOLOGICAL AND TAPHONOMICAL INVESTIGATIONS IN THE VILLAGE OF HESBAN

Øystein Sakala LaBianca

Chapter Two

Ethnoarchaeological and Taphonomical Investigations in the Village of Hesban

Introduction

The existence of a thriving village on the slopes leading up to the ancient site of Tell Hesban is something which anyone who ever visits the place cannot fail to notice (pl. 2.1). That this village—especially the material culture of its inhabitants—would itself become the object of investigations by members of the Heshbon Expedition is to a large degree a consequence of the quest for answers to a host of questions which arose in connection with the expedition's bone work.

As noted in chapter 1, there existed among archaeologists working in Syro-Palestine in the late-1960s and early-1970s neither a compelling theoretical rationale for why animal bones from historical sites should be collected, nor any established procedure for how such work should be done. To begin with, the fundamental assumption that the large quantities of animal bones which routinely were uncovered at historical tells in Palestine could somehow be identified and analyzed in some meaningful way remained largely untested from the point of view of most leading Syro-Palestinian archaeologists at the time. A related problem was uncertainty about what sorts of questions one might appropriately expect the study of animal bones from such sites to answer.

While such fundamental concerns were voiced in discussions between Heshbon Expedition staff members, the existence of the present-day agricultural village on the slopes of the tell, along with the

Plate 2.1 The village of Hesban, Summer 1974.

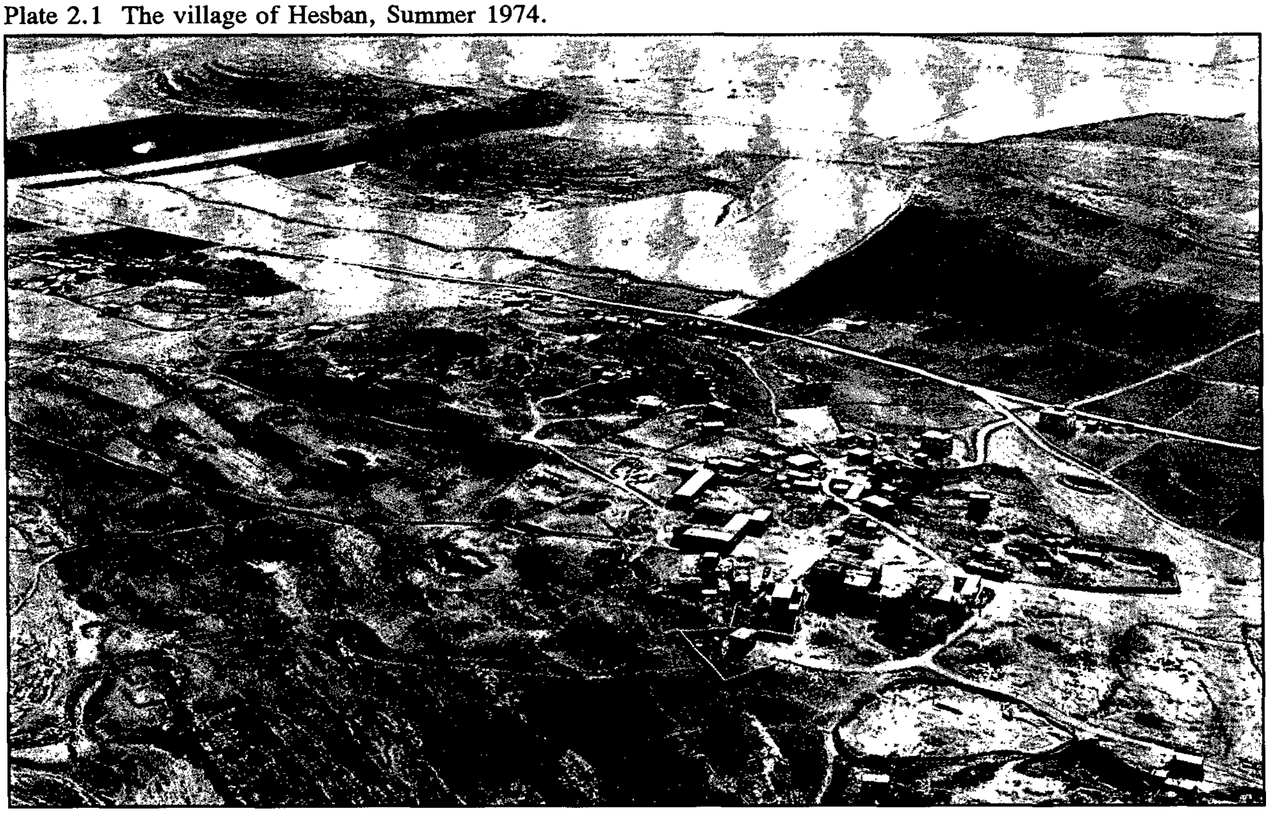
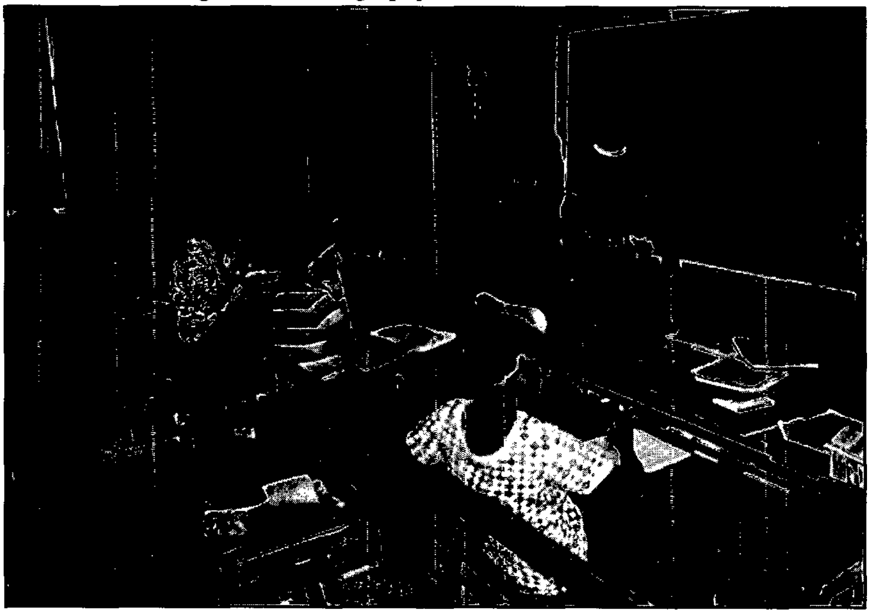


Plate 2.2 Meeting of the ethnography team, 1976.



steady accumulation of bones of domestic animals in the bone lab, led to new questions being asked. Given the occurrence in the village of Hesban of the same species of animals as were turning up in the excavations, what accounts for this continuity? Could studies of present-day animal husbandry practices somehow generate insights that might be useful in interpreting the bones uncovered in our excavations? To what extent does the keeping of animals influence other aspects of the material culture? What happens to the bone refuse after people eat meat in the village? What happens to the carcasses of "unclean" animals, such as donkeys and horses, when they die? How do the bones of certain wild animals end up becoming a part of the refuse of a village? Are there some parts of an animal's skeleton which are more likely to be preserved in the archaeological record than others? Are some species more likely to be preserved?

It was in order to begin to answer some of these questions that ethnoarchaeological and taphonomical fieldwork got underway in the village of Hesban. That some fruit resulted from this fledgling beginning is in no small measure due to the hospitality and cooperation of the villagers of Hesban. They opened their homes and their lives to me and my young assistants, and won for the country of Jordan and its people untold goodwill and friendship.

Objectives, Personnel and Procedures

As already indicated, a major objective of our research in the present-day village of Hesban was to learn more about how the skeletal parts of domestic animals are added to the archaeological record so as to put on firmer ground the theoretical rationale for bothering to save and study the remains of animals from archaeological sites, such as Tell Hesban. To this end a number of related lines of inquiry were begun. These included taking a census of the present-day animal population in Hesban; finding out about different ways in which animals are sheltered; investigating how animals are butchered; learning about meals containing the flesh of animals; ascertaining how animal wastes are disposed of; examining the role of common scavengers in getting rid of animal wastes; and taking a survey of animal bones scattered on the ground throughout the village.

The discussion which follows draws heavily on observations and field notes collected in the village of Hesban by several assistants assigned to work on my team as ethnographers (pl. 2.2). These individuals were Shirley Finneman and Douglas Fuller during the 1974 season; and Pamela Butterworth, Mary Ann Casebolt, Del Downing, Theresa Fuentes, and Asta Sakala LaBianca during the 1976 season. All were either current college students in the US or recent college graduates. None had any formal training in anthropology, nor could any of them speak Arabic other than what they picked up during their fieldwork. Their communication was facilitated, however, by the fact that several of the younger men and women in the village spoke a little English, and by the help of a hired translator, namely Samir Ghishan (pl. 2.3).

The investigations carried out by these individuals were coordinated by me—then a graduate student in anthropology—as a sideline to my principal task, which (as in previous seasons) was to be responsible for the bone work. My role consisted of setting priorities with respect to what sorts of observations and interviews these assistants should carry out. I also provided guidelines for recording and cataloguing the information collected and spent numerous hours in conferences with each member of the team discussing progress and planning their daily goals and activities in the village.

While the scope of the ethnographic inquiries during the 1974 and 1976 seasons went beyond studies of practices strictly related to people's use of animals, as already indicated, a number of observations carried out by our team were directly related to this subject. I have selected from my assistants' and my own field notes those portions which I felt were relevant to this topic. So as to make explicit the respective contributions of the various assistants to collection and recording of the different lines of information reported here, I give their names whenever appropriate as I introduce each new topic.

Plate 2.3 Samir Ghishan (seated left), 1976.

The Hierarchy of Animals in the Village of Hesban (as observed and reported by Douglas Fuller; Summer 1974)

The animal which is on the top of the hierarchy of animals in the village of Hesban is the purebred Arabian horse (pl. 2.4). His lofty position among the animals is due to several factors. First, horses are considered by Arabs to be the most friendly to men (who, incidentally, are the only people who ride them, except the boys with permission). Secondly, horses are very useful in transportation because of their speed, endurance, and intelligence. In addition, because of their scarcity in Jordan, purebred Arabian horses are quite expensive. Consequently, only the wealthy can obtain them. Generally, people regard horses to be fairly intelligent and, therefore, treat them with considerable care and affection.

Because of the small size of the village of Hesban, there are few people wealthy enough to own pure Arabian stock. However, villagers can obtain a horse by purchasing cheaper-priced stock. These horses are also Arabian, but of inferior breeding and, thus, have less speed and beauty than the pure stock. They can be purchased from agents in the city, whereas most of the purebred stock are either in the stables of the king or are kept for racing by the wealthy.

Most Hesban villagers have not much use for the horse as a riding animal; the majority use them as beasts of burden. Among their tasks are the pulling of crude plows for cultivating, carrying supplies from the market, and a host of other chores. However, the treatment given them is better than that given to any other animal in the village. They are not used for food except in the rare cases, such as starvation. This is not so much due to the fact that they are considered unclean, as it is a result of their versatility and value.

Because of the high position of horses on the hierarchical scale, they are the least abused of all the domesticated animals. Although they are not treated as well as the horses of American owners, in general, their plight rates from fair to good. Thus, the horses we saw in the village are provided with adequate shelter, food, and water. A barn or shed is sometimes provided for them. Oats and hay

Plate 2.4 Horses.

Plate 2.5 Sheep.

Plate 2.6 Goats.

Plate 2.7 Cattle.

Plate 2.8 Chickens.

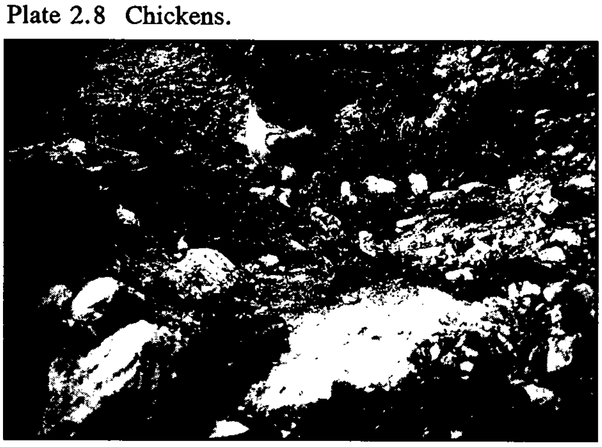


Plate 2.9 Donkeys.

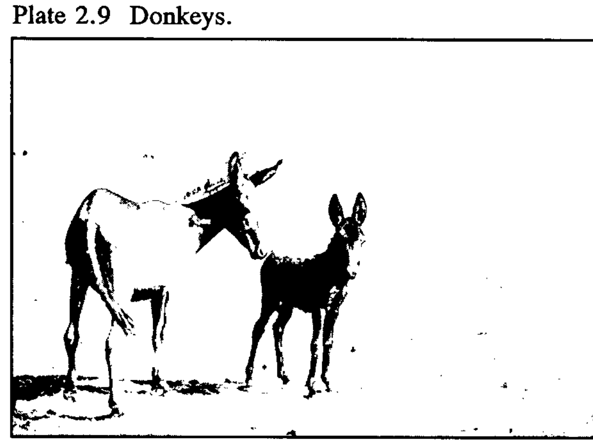


Plate 2.10 Dog.

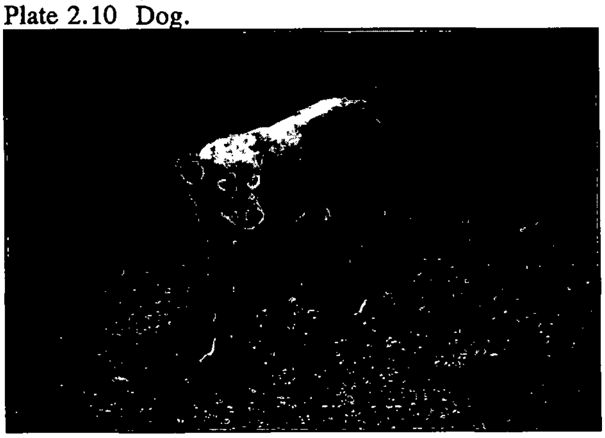


Plate 2.11 Cats.

Plate 2.12 Camel.

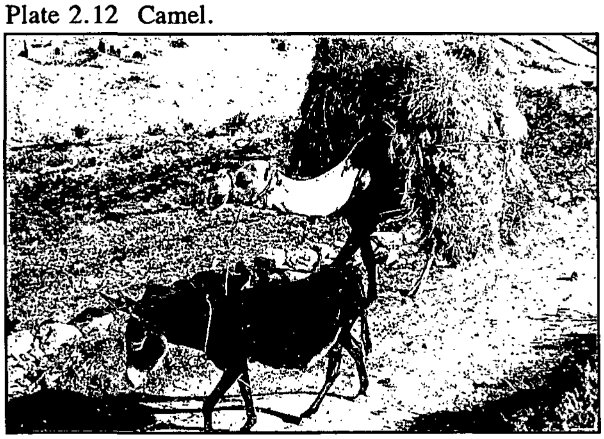


Plate 2.13 Rooster.

Plate 2.14 Rabbit.

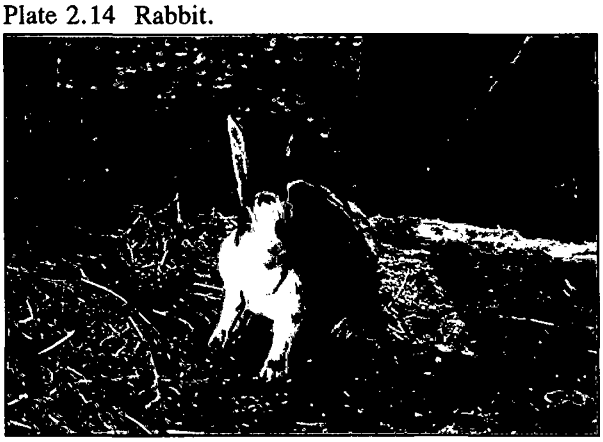
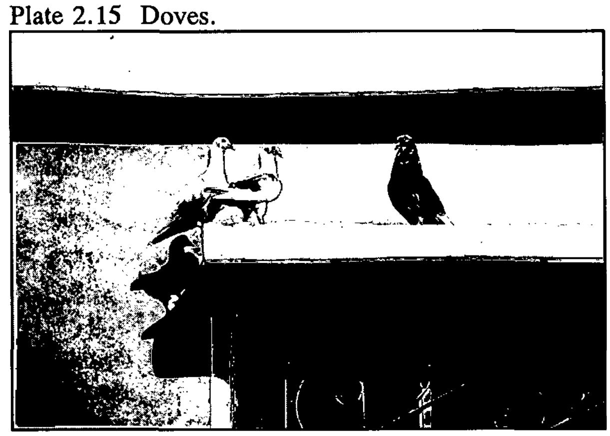


Plate 2.15 Doves.



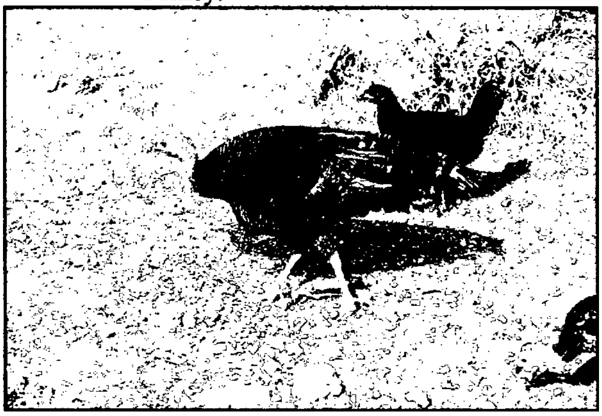


Plate 2.16 Turkey.

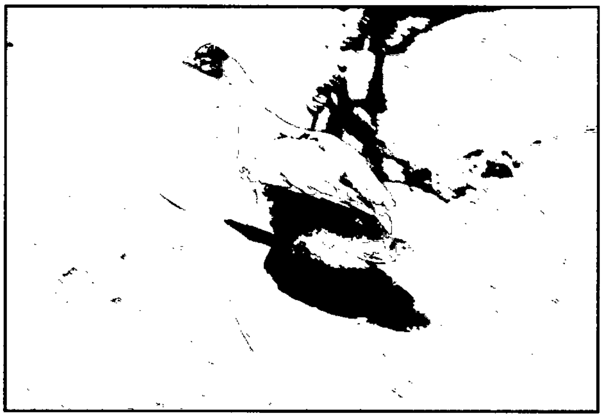


Plate 2.17 Goose.

are usually given twice a day and cistern water is provided several times each day. However, the personal attention factors of brushing and cleaning are often neglected or ignored. The reasons for this are varied, but stem in general from the fact that villagers view animals as creatures to be worked and, thus, are not to be fussed over. The combination of hard work and lack of proper rest results in some physical degeneracy in some of the horses.

Next to the horse, in the hierarchical order, are the sheep and goats (pls. 2.5 and 2.6). Their high status stems in part from the high price their meat brings at city markets, and in part from the value of the milk and skins they produce. In Hesban, sheep and goats are the most numerous of the hooved animals. Both the sheep and the goats are considered to be clean for food.

Third down on the scale of animals is the cow (pl. 2.7). There are more cows than horses, but far less than sheep and goats. Their importance is primarily for the marketing of by-products, such as milk, cheese, and butter. They are also considered clean, but are rarely slaughtered for food.

Fourth place is given to chickens (pl. 2.8). There appears to be even more of them in the village than there are sheep and goats. They are kept primarily to provide their owners with fresh eggs, which are preferred to those bought in the city markets. Use of the chickens as flesh food is not considered on par with sheep's and goat's meat—although they are considered clean to eat.

At the bottom of the list of husbandry animals are donkeys, which are the chief beasts of burden in the village (pl. 2.9). They are treated with less kindness and care than are the other animals, due in part to the fact that they are inherently stubborn and need to be coaxed.

Dogs and cats can hardly be said to be regarded as pets and are surely not treated as such (pls. 2.10 and 2.11). Although they are allowed in the house, or tent, to feed from the scraps which are thrown on the floor, they have to fend for themselves in every way, snatching what food or water they can from the family's supply. They are rarely cleaned, washed, or treated for sickness; consequently, they are infested with parasites.

Animal Census of the Village of Hesban (as observed and reported by Del Downing, Mary Ann Casebolt, and Theresa Fuentes; Summer 1976)

During the last week of July, Del, Mary Ann, and Theresa were asked to carry out a census of animals and stationary objects in the village of Hesban. They were to focus only on what could be counted simply by walking slowly through different sectors of the village. To this end, the village was divided up into three different census tracts, and Del, Mary Ann, and Theresa were each assigned a tract in which to carry out their census. Their precise instructions were to tally the number of houses, tents, cisterns, cars, trucks, tractors, TV antennas, as well as different types of animals and cultivated plants observable within their respective tracts. Their census was carried out during the morning hours between 6 am and 12 noon. Their combined result, as tallied by Del, yielded the final results listed in table 2.1.

Table 2.1 Census of animals and stationary objects in the village of Hesban.

Animals		Objects	
chickens	755	houses	152
sheep	447	tents	52
goats	281	cisterns	41
donkeys	88	cultigens	33
pigeons	75	tractors	9
rabbits	39	TV antennas	9
turkeys	35	cars	3
dogs	35	trucks	1
cows	30		
cats	29		
horses	27		
geese	7		
ducks	1		

Some comments on these results are in order. To begin with, camels and pigs are conspicuously absent. One reason for the absence of camels is, according to testimony by villagers, the introduction of pick-up trucks and tractors, which have taken over the heavy hauling which camels used to have to do (pl. 2.12). The absence of pigs comes as no surprise, for the people of Hesban are Muslims. For them, therefore, the keeping of pigs is strictly prohibited on religious grounds. That the quantity of sheep and goats are under-represented is possible, as in some cases, shepherds will overnight with their flocks away from home.

Sheltering of Animals in the Village of Hesban (as observed and reported by Øystein and Asta LaBianca, Del Downing, Mary Ann Casebolt, Theresa Fuentes, and Pam Butterworth; Summers 1974, 1976)

Villagers at Hesban do not have specially built barns in which they keep their animals sheltered. Instead, they shelter their livestock using whatever they have on hand that can provide a roof and protection for their animals. In many cases, abandoned, old-fashioned stone houses—which were formerly inhabited by people—are used as shelters for horses, cows, sheep, and goats. An example is the building the villagers call the Qasr in the center of the village. It serves as a stable for horses and cows (pl. 2.18).

Another common place to keep animals is in caves located nearby villagers' houses. In some cases, houses are practically built right on top of the caves. There is usually some sort of makeshift

Plate 2.18 A portion of the Ottoman farm building in the center of the village has been put to use as stables for horses and cattle.

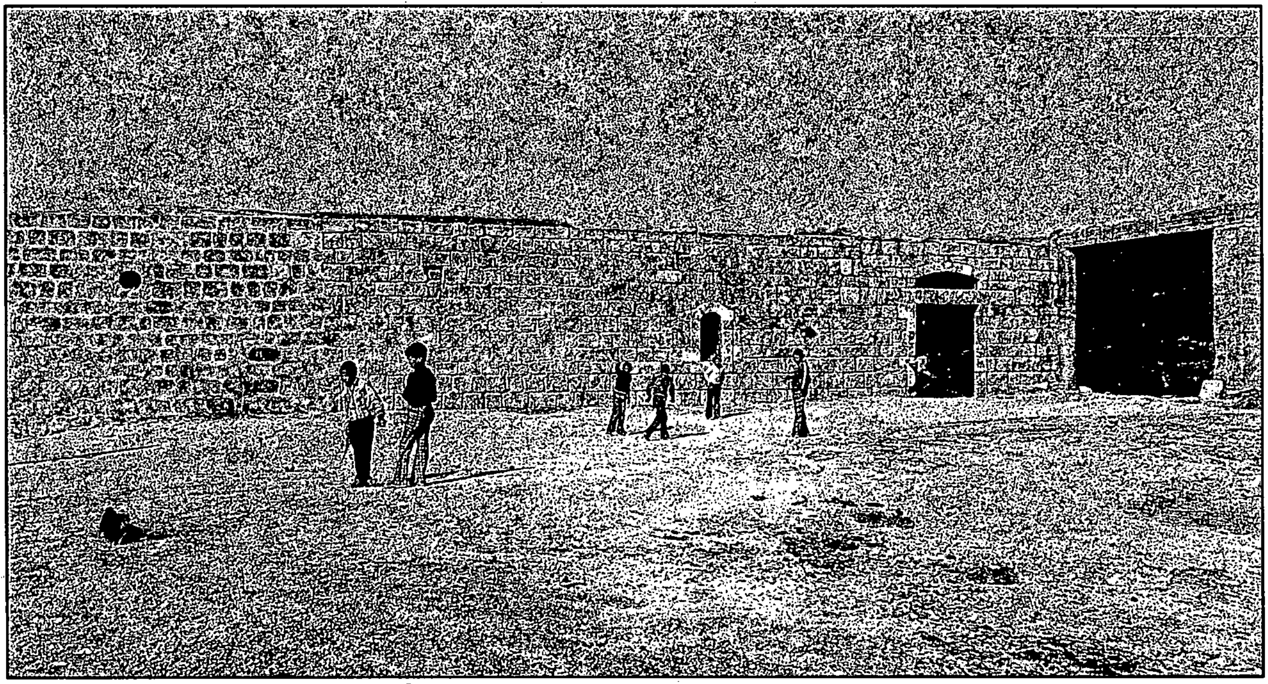


Plate 2.19 Abandoned residential caves are the most common form of shelter for sheep and goats.

door that can be closed or opened. Fodder is also often stored in these caves.

In some cases, pens—consisting of an enclosed area surrounded by a wall of field stones—are used for safe-keeping of animals at night. A cave or abandoned house is often found inside or abutting these pens so that the animals can have a place to go underneath for shelter (pls. 2.19 and 2.20).

Villagers' tents are also sometimes used to shelter flocks by night. This is especially the case during the dry months of spring, summer, and fall when some or all members of the family will move into their tents in order to be more mobile in search of pastures for their flocks. In such instances, the flocks of sheep and goats can be seen encircling the tent; some animals may even slip in.

A wide variety of methods are used for sheltering poultry (pls. 2.21) and rabbits (pl. 2.22). At times, small makeshift tents are used (pl. 2.23).

Plate 2.20 A herding station complete with caves and animal pen in the foreground.

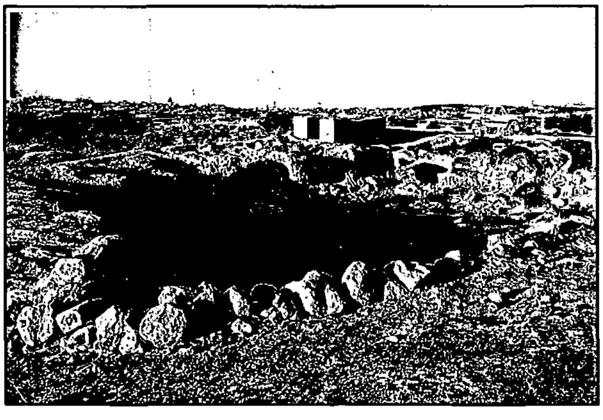
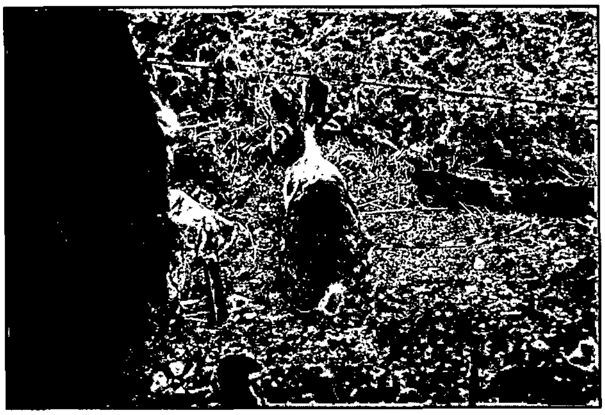


Plate 2.21 Chicken coop made of field stones and wood.

Plate 2.22 Rabbits are sometimes sheltered in small tents.



Sometimes field stones are used to construct a makeshift shed, which may be covered by bramble, cloth, or some other material (pl. 2.24). Some

Plate 2.23 Makeshift barnyard shelter made of canvas, wire, and sticks.

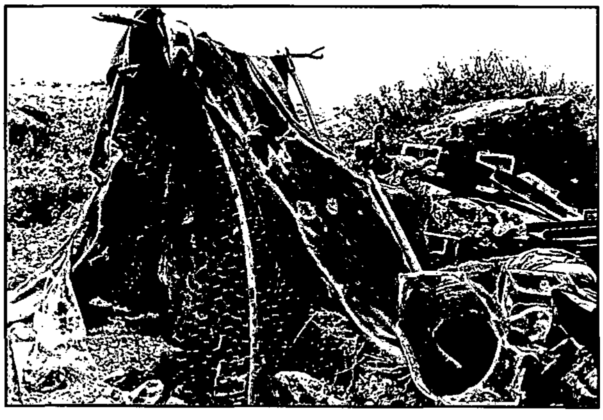
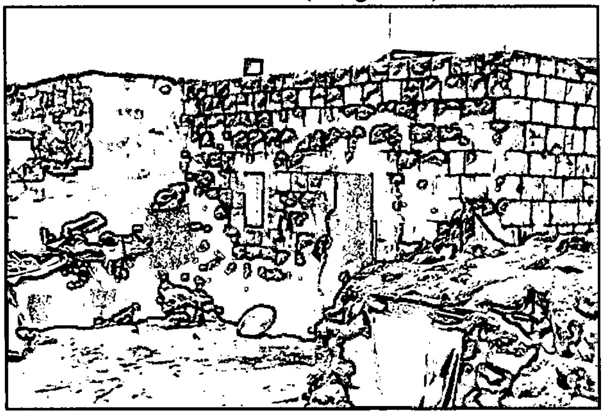


Plate 2.24 Village house with barnyard shelter made of field stones and canvas (foreground).



yards include rows or clusters of small bird houses which are mounted several feet above the ground. These are made especially to attract and raise doves (pl. 2.25).

Sketches showing the arrangement of different types of animal shelters in people's backyards were drawn by Pam Butterworth and Asta LaBianca. Prominent in Pam's sketches are the miniature tents used for sheltering chicken and rabbits. Asta's sketch includes a row of pigeon houses and the entrance to a cave used for sheltering sheep and goats.

Butchering of Animals in the Village of Hesban (as observed and reported by Douglas Fuller; Summer 1974)

The Islamic method for butchering goats is very similar to the ancient Hebrew way. First, the best

Plate 2.25 Dove cages made of canvas, wood, and stone.

male goat is selected from the herd, usually "without spot or blemish." Females are seldom used due to their value as milk and cheese producers. After being selected, the goat is led by a rope to the slaughtering ground. This usually consists of a small concrete wall enclosure with an earthen floor. A mat of some sort is placed on the ground on which the goat is positioned prior to killing. Once the goat has entered the enclosure, the rope is removed from around his neck and two men grasp both sets of legs. The goat is then placed on his side so the mat completely covers the under side of the body.

Next, one of the men selects a sharp foot-long knife which he grasps in his right hand. With his left hand he grabs the goat's head and pulls it back exposing the maximum neck distance. The Arabs do not club or shoot their animals prior to slaughter. Consequently, the animal jerks, bleats, and kicks during the entire ordeal. (This seems rather barbaric and inhumane, but it serves an important function. If the animal was killed prior to the slaughter, the blood would not pump out of the body once the neck had been slit. This would make the animal unclean to the Muslim who adheres to the ritual prohibition against fat or blood.)

Once the neck is exposed, a sharp knife can penetrate through with one slash. (However, in our case this was not accomplished. Consequently, the man had to saw through the mid-section of the neck.) The slit is made in a perpendicular position to the horizontal axis at the front of the neck just under the mandible. This serves as the best area to cut the main artery of the throat. Once the neck has been penetrated, the head is pulled further back providing optimal room for the escape of the blood that is pumped out of the artery.

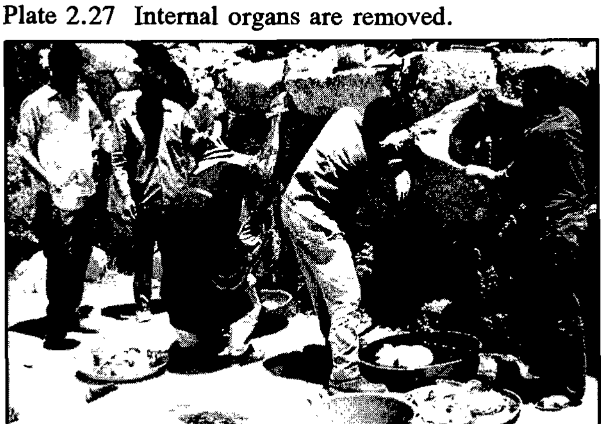
It is not uncommon for the blood to squirt three feet into the air from the pressure within the artery. At this point the man holding the hind legs releases them and the goat, still on his side, kicks, and jerks for about fifteen seconds. At this time the goat is considered dead and only a trickle of blood continues to flow. Several men then take hold of the front and rear legs. With the use of knives, they sever the tendons just above the ankle joints. Next, the foot is twisted completely off and tossed aside on the mat. The head is then completely cut off from the neck and laid aside to be boiled later as a feast delicacy.

Plate 2.26 Animal is skinned.

Next, two slits, one behind each back leg, are made starting from the butt down to the severed ankle stump. The skin is then peeled back from around the legs and thighs forward to the ribs (pl. 2.26). Once this is done the goat is lifted up to the concrete wall and hung upside down on pegs. The hanging process can be done either by placing the peg between the distal ends of the tibia and fibula, resulting in an upside down V-shaped hook, or the pegs can be driven through the distal ends of the tibia thus securing the bones to the wall. In our case the first option was used. The rest of the skin is then peeled forward from the ribs to the neck. The skin will later be cleaned and used as a rug or mat. In the meantime, the remainder of the blood is drained out and the meat cutting may begin.

Water is now brought to wash down the carcass, removing all dirt and debris. Next all fat covering the body is scraped and cut away with knives and hatchets. Once this is finished, a ventral slit is made from the crotch and extending forward

Plate 2.27 Internal organs are removed.



to the neck. Next the ribs are pulled slightly apart exposing the body organs. They are then removed and placed on an oval platter brought to the mat (pl. 2.27). Water is again used to wash the inside of the cavity removing all remaining blood. Now the front legs are cut off just below the shoulders. These are also placed on the platter.

Two side cuts are made next, one on each rib half starting from the thighs and working forward to the shoulders. These ribs are placed with the other pieces. Lastly, the remainder of the goat is taken down and the hind legs are cut from the butt. These are also put into the dish. Virtually nothing is wasted but the hooves.

Next, several men gather around the platter and each obtains a knife, or small hatchet, to cut the pieces into small cubes. After this is completed, several women come and take the platter away to be placed on top of a stove or open pit fire for baking. The kidneys are usually cooked first so as to be available before the main feast. These appetizers are accompanied by tea and coffee.

Earlier, in the summer of 1973, I observed and reported on a similar butchering process (LaBianca and LaBianca 1975: 241, 242). I went beyond Doug in describing how the different bones were sectioned, however, as I wanted to learn the extent to which the butchering process accounted for the fragmentation patterning I had observed in the bones excavated on the tell. A striking similarity was noted between the types of fragments produced by present-day practices and those which prevailed in antiquity (LaBianca and LaBianca 1975: 243-245).

Meals Containing the Flesh of Animals Served in the Village of Hesban (as reported by Mary Ann Casebolt, Theresa Fuentes, and Asta Sakala LaBianca; Summer 1976)

Perhaps the most frequently encountered of activities related to food-getting in the village of Hesban was meal preparation. Literally dozens of accounts of meals being prepared were recorded by our team. What is striking about this data, however, is how relatively infrequent are meals that actually call for animals to be slaughtered. Most everyday meals served in the village were, in other words, meatless. When meat was served, it more often than not was obtained from the butcher

Plate 2.28 The Mansef plate.

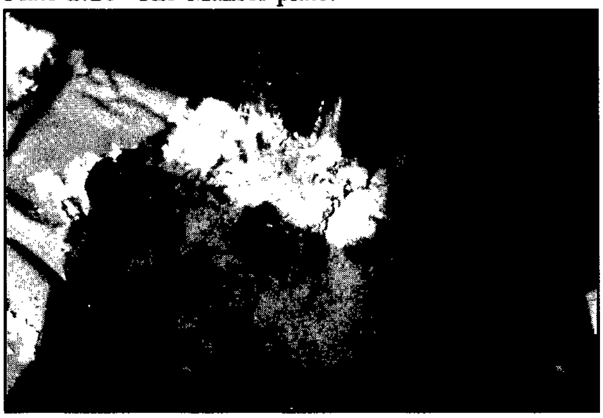


Plate 2.29 Internal organs are discarded nearby.

shop in nearby Madaba, not from an animal being slaughtered in the village. The latter only occurred on special occasions. As a general rule, the wealthier the family, the more likely that meals would include the flesh of animals.

The "Mansef" is perhaps the most notable meal containing the flesh of animals. It calls for one or more sheep or goats to be slaughtered and sectioned, as described above, into small pieces. The pieces of meat are placed on top of a platter which is heaped full of rice (pl. 2.28). A sauce made from the fat of the sheep's tail and other ingredients is poured on top of the dish. Another important flesh meal is "Chicken Magluba," which calls for one or more whole chickens to be slaughtered and served. Like the Mansef, it involves the pieces of chicken being served on a platter heaped full of rice. A special sauce is also required. Many other meals call for pieces of meat of various animals, but these are by far the most commonly served meals on occasions when flesh foods are called for.

Disposal of Animal Wastes by Hesban Villagers (as observed and reported by Øystein S. LaBianca; Summers 1973, 1974, 1976)

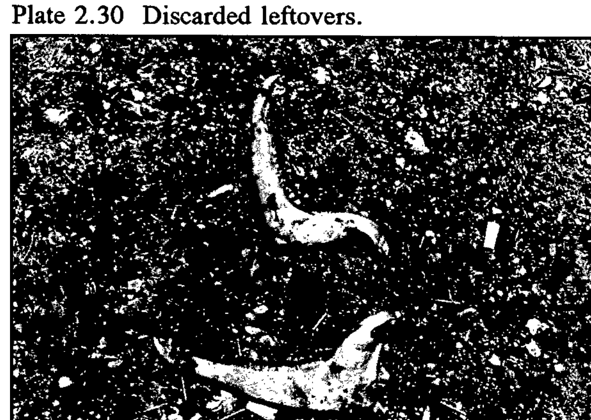
As a general rule, not every part of the animals which are slaughtered for meat are eaten by humans. For example, as noted above, blood is not saved and is simply allowed to be soaked up by the ground on which it spills. Many of the soft innards of the animals are also discarded, such as the stomach, the intestines, the liver, and related parts. On several occasions I observed such parts being carried a short distance away from where the animals were being butchered to some temporary disposal site where it was expected that scavengers would discover them and eat them (pl. 2.29).

The other point at which animal wastes are disposed of is after the meal. What is normally thrown away, of course, are the fragments of bones which remain after the meat has been consumed (pl. 2.30). Typically, such fragments are gathered and literally "thrown to the dogs," which are eagerly waiting for them outside in the yard or on the periphery of where people are gathered—in the case of ceremonial meals such as the Mansef.

Common Scavengers in the Village of Hesban (as reported by Øystein S. LaBianca; Summers 1974, 1976)

By far the most important scavenger at Hesban is the domestic dog. On numerous occasions, we observed dogs scrambling to get possession of

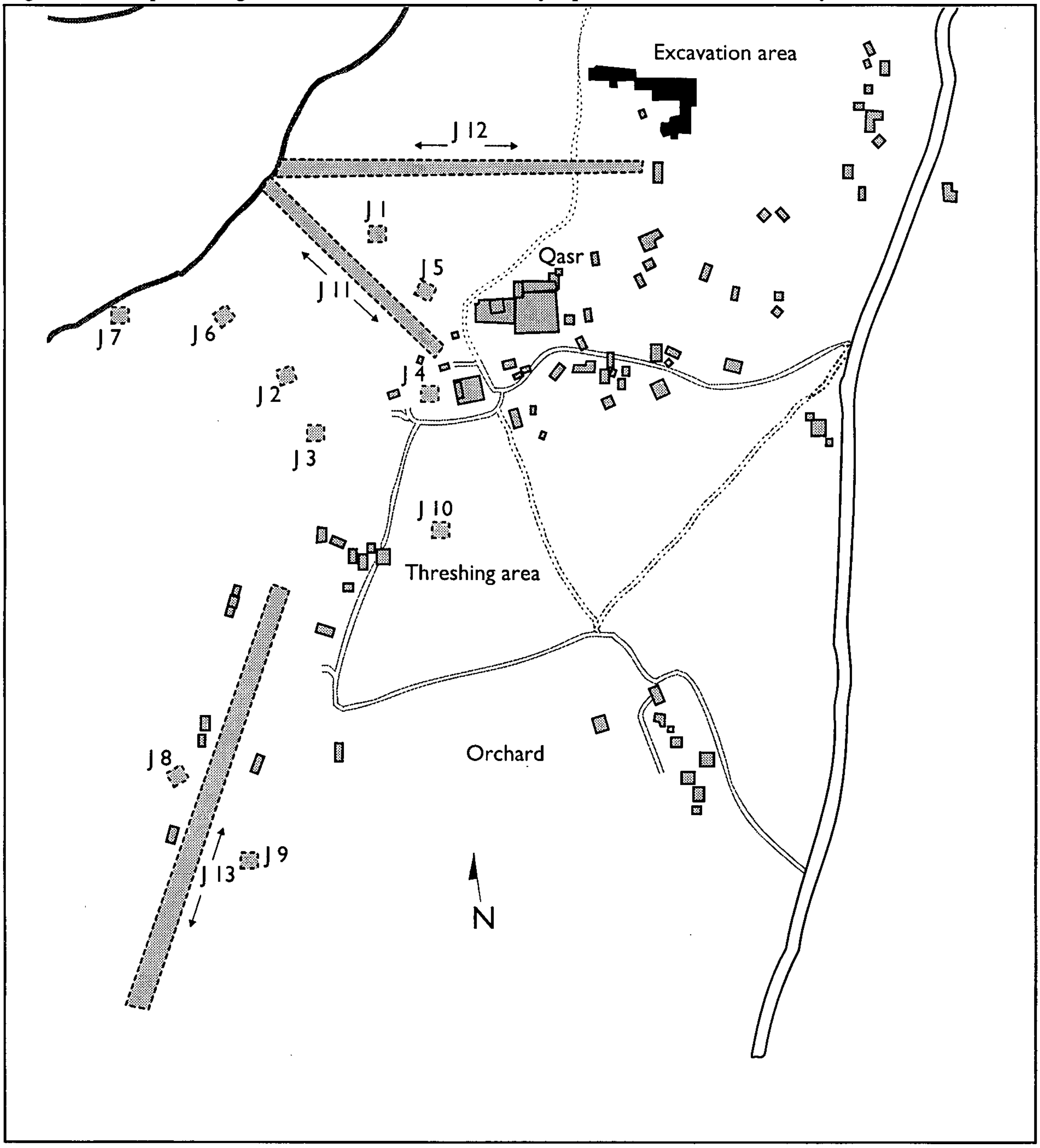
Plate 2.30 Discarded leftovers.



bones thrown their direction by people. The extent to which dogs are capable of actually consuming the bones of various animals depends, on the one hand, on the size and strength of the animals' jaws, and, on the other hand, on the hardness of the bones it attempts to eat. As a general rule, the softer the skeletal part, the more likely that it will be completely consumed by dogs.

Least likely to survive the scavenging of dogs are the bones of poultry of all kinds. On numerous occasions we observed dogs consume every bone that had come their way following a chicken dinner. Also likely to be chewed up and eaten by dogs are the softer parts—such as scapula blades,

Figure 2.1 Map showing the location of intensive survey squares and extensive survey tracts.



vertebrae, and the shafts of long bones—of various hooved animals, such as cattle, sheep, and goats.

Dogs are also responsible for a large number of bones of various unclean animals being transported into the village. Whenever they find a freshly killed or dead animal carcass—be it that of a donkey, a goat, or a rabbit—they will get in there and take what they can get. When what is left is too large for them to eat right there and then, they will haul it with them back to the yard where they belong, and either bury the bone for future consumption, or lie down and gnaw away on it until it is partially, or completely, consumed.

Another very important consumer of animal wastes are the ubiquitous domestic chickens, which are allowed to wander all around people's backyards in search of things to eat. As they are not normally fed very much by their keepers, they are aggressive in seeking out discarded animal wastes of any kind, whether it be innards or scraps of meat still attached to discarded bones.

It is our impression that together, dogs and chickens are the most successful scavengers of animal wastes in the present-day village of Hesban. There are other players as well, particularly hyenas and vultures. Whereas a hyena was spotted only on one occasion by a member of our team, the Griffon vultures and Egyptian vultures were seen on at least two separate occasions (Alomia 1978). The contribution of these animals to the elimination of animal wastes is minuscule, however, in comparison to that of dogs and chickens.

Taphonomical Survey in the Village of Hesban

(as reported by Øystein S. LaBianca; Summer 1976)

Despite the scavenging habits of dogs and other animals, bones of domestic animals are not completely eliminated from the fields and backyards of villagers at Hesban. As one walks around, one notices here and there scattered bone fragments; sometimes even partially articulated skeletons of recently killed animals. This situation gave rise to the idea of a taphonomical survey in which all bone fragments found within pre-selected sampling units would be collected and identified to see the extent to which they might serve as a basis for reconstructing the composition of animals in the village as revealed by the above-mentioned census.

Plate 2.31 Bone survey in process.

The survey had an intensive component and an extensive component to it as shown on the map (fig. 2.1). The former entailed intensive scrutiny—including the use of a stick to turn over stones and move vegetation or garbage—of ten 5 × 5 m squares (pl. 2.31). Some of these were located in the center of the village, others were located on its edges (pls. 2.32-2.35). The latter, namely the extensive survey, entailed scrutiny of fifty-three 15 × 15 m squares, with only eight minutes being allotted to survey each square. The squares were laid out in three different tracts as shown on the map. In both surveys, any fragment of bone that was found was picked up and placed in a bag for subsequent identification and analysis (pl. 2.36).

The bones collected in both surveys were identified and weighed by Joachim Boessneck and Angela von den Driesch. Their results, arranged according to weight, are presented in table 2.2.

At this point we can come back to the question

Plate 2.32 Survey square located in the village center.

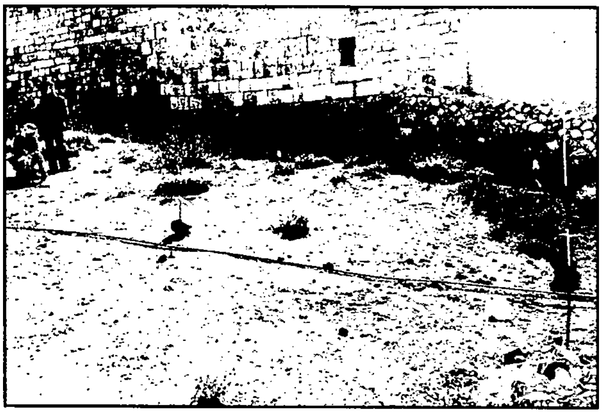


Plate 2.33 Survey square located next to a family dwelling.

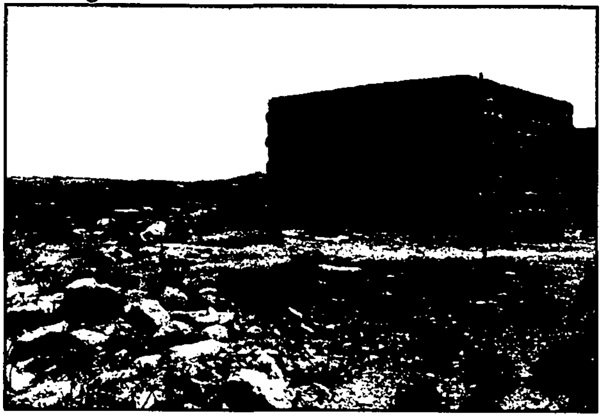


Plate 2.34 Survey square near bedouin tent on the periphery of the village.

regarding the extent to which bones which are found lying on the ground in a given area are reflective in some way of the composition of living

Plate 2.35 Survey square in agricultural field on the periphery of the village.

Plate 2.36 Bones found on the surface are collected.

animals in the same area. Before doing so, however, it is necessary to lump together all sheep and goat bones, and all horse and donkey bones, as these had large numbers of fragments which couldn't be separated down to the species level. Our analysis (table 2.3) will consist of ordering the species according to tally order based on A) the census of living animals; B) total number of bones belonging to different species and C) weight of all bones belonging to each species.

The most striking insight which emerges from the above comparisons is the extent to which the bone survey results are skewed in favor of larger animals. Thus, the chicken was the most common species observed in the village, yet only 4 chicken

Table 2.2 Bones collected from the Hesban village taphonomical survey.

Species	Fragments	Weight
goat	125	2.610 kg
horse	28	2.655 kg
sheep/goat	317	1.670 kg
camel	38	1.540 kg
donkey	21	1.265 kg
horse/donkey	48	1.125 kg
cattle	33	.835 kg
sheep	35	.570 kg
dog	36	.545 kg
human	3	.050 kg
gazelle	1	.010 kg
chicken	4	.005 kg
cat	2	.002 kg
pigeon	1	.001 kg

Table 2.3 Hesban village animals.

Village Census	Bone Count	Bone Weight
chickens	sheep/goat	horse/donkey
sheep/goats	horse/donkey	sheep/goat
horses/donkeys	camel	camel
pigeons	cattle	cattle
rabbits	dog	dog
turkeys	chicken	gazelle
dogs	cat	cat
cattle	pigeon	pigeon
cats		
geese		
ducks		

bones turned up in the bone survey. The only other evidence of poultry which the survey produced was a lone pigeon bone. Missing is any evidence of the presence of turkeys, ducks, and geese. It is interesting to note what happens to these three sets of data when the poultry is treated separately from the other species (table 2.4).

What is significant about this latter arrangement is that it points to the weaknesses in both surveys. For example, the remains of camel and gazelle were attested in the bone survey, but not in the village census. On the other hand, rabbits were seen in the village, but not attested in the bone survey. Also in this re-arrangement of the data,

Table 2.4 Hesban village animals, poultry separated.

Village Census	Bone Count	Bone Weight
a. non-poultry		
sheep/goats	sheep/goat	horse/donkey
horses/donkeys	horse/donkey	sheep/goat
rabbits	camel	camel
dogs	cattle	cattle
cattle	dog	dog
cats	cat	gazelle
	gazelle	cat
b. poultry		
chickens	chicken	chicken
turkeys	pigeon	pigeon
geese		
ducks		

however, the tendency for bones of larger species to be over-represented is seen in the fact that dogs were higher up in the village census data than in the bone survey.

Toward a Firmer Theoretical Rationale for the Study of Animal Bones from Historical Tell Sites (as contributed by Øystein S. LaBianca)

Despite the fledgling nature of these ethnoarchaeological and taphonomical inquiries, they were crucial in helping to establish a firmer theoretical rationale for the study of the animal bones from Tell Hesban. In other words, they served to provide plausible answers to those who were curious or doubtful about the assumptions on which this line of research was based. They therefore, ultimately strengthened the case for zooarchaeological analysis of bones from tell sites in several ways.

Perhaps the most fundamental way in which they did so was in heightening awareness of the extent of the continuity between the past and the present as far as exploitation of animals was concerned. In terms of the types of animals utilized, for example, there was almost no difference between the past and the present except with regard to the use of pigs. The latter was not found in the village of Hesban, but occurred quite commonly during the Roman and Byzantine centuries.

This recognition of the present as being simply the latest phase in a succession of historical phases going back into antiquity was an important conceptual breakthrough, for it brought into focus the ethnographic present as a legitimate period of study for our team of archaeologists. In other words, it opened wide the door to further studies of the present for its own sake as well as for the sake of generating insights for use in making sense out of the fragmentary archaeological record of the past.

The culmination of these ethnographic inquiries was the development of the Food Systems concept for use in fitting together many different types of data stemming from many different historical periods in Hesban's past. As I've explained elsewhere (LaBianca 1984, 1986, 1992), this concept not only provides a solid theoretical rationale for why the study of animal bones from historical sites such as Tell Hesban is important, it also provides a methodology for fitting together the results of such studies with other types of data produced by archaeologists. It does so by focusing attention on the dynamic nature of food systems as implied by the notions of intensification and abatement, and sedentarization and nomadization (LaBianca 1990).

Most important, perhaps, for the present volume, is the significance of the food system concept—and the related concept of the ecosystem—for understanding how and why the zooarchaeological record is constituted. It is what it is, of course, because people and animals live together in symbiotic relationships—they are webbed together in a myriad of ways which contribute both to their well-being as creatures as well as to their demise as living and dead organisms.

Why animals have played such an important role in traditional human communities is, of course, because they have been useful to their human masters. They provide raw materials for food, clothing, and shelter; they provide traction power for plowing and transportation for people and their goods; they consume a significant proportion of the refuse discarded by humans; and when sacrificed, their flesh and blood provides food.

Humans are also useful, to some extent, to the animals which they exploit. They provide a certain amount of safety from predation by other creatures; they sometimes provide shelter from the elements; they provide lands for grazing and fodder for feed; they foster opportunities for their animals to procreate and multiply as a species.

It is, of course, the quest for food that brings a host of "civilization followers" into contact with human communities as well. Rodents, for example, are attracted by human refuse and by food stores maintained by humans. Their predators, in turn—snakes, foxes, hawks—are drawn to human communities because of the delectable prey which live among them. Humans defend against their rodent cohabitants and other civilization followers by keeping cats and dogs. As also noted earlier, the latter, because of its eating habits, is the single most important agent in bringing the bones of "unclean" animals back into human settlements and in crushing and wasting bones discarded by humans.

Another benefit, then, of the ethnoarchaeological and taphonomic inquiries was that it focused our attention on the complex eco-systemic interactions which contribute to the formation of the zooarchaeological record at a site such as Tell Hesban. This research has not only helped us move beyond simplistic assumptions about the role of animals in the subsistence activities of traditional villagers; it has also brought into focus an awareness of the contribution which the more general notion of the ecosystem can contribute to helping us understand why the biases of the zooarchaeological record are what they are. Thus, while they have served to legitimize the bone work as an integral part of tell archaeology, they have also greatly increased our awareness of the processes which destroy a goodly proportion of the data on which this work depends.

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Chapter Three

THE NATURE OF THE ZOOARCHAEOLOGICAL RECORD AT TELL HESBAN

Øystein Sakala LaBianca

Chapter Three

The Nature of the Zooarchaeological Record at Tell Hesban

Introduction

Like most other Syro-Palestinian tells, Tell Hesban owes its existence to successive generations of people having elected to make it their home. Assuming that the site was settled on a permanent basis for the first time sometime during the early Iron Age (*ca.* 1200-900 B.C.), and assuming that a new generation arose every 20 years, it has taken an estimated 145-160 successive generations to produce the debris which today makes up the archaeological record of Tell Hesban.

The extent to which each of these successive generations contributed to the build-up of the archaeological record varied substantially over time. During some periods, people merely camped on the site dwelling in tents and caves, while during others, they built from locally quarried stone permanent dwellings, market squares, paved streets and places of worship. In other words, as I have explained in greater detail elsewhere (LaBianca 1990), the site has undergone periods of sedentarization (when building activity flourished as people settled down in farmsteads, villages, and towns) and periods of nomadization (when people abandoned such permanent settlements and returned to more nomadic ways). The build-up of archaeological strata—including the accumulation of the zooarchaeological record—appears to have been most intense during periods when sedentarization prevailed.

The purpose of the present chapter is to focus attention on the archaeological context of Tell Hesban's faunal assemblage. To this end, we shall begin by describing the areas of the tell which produced the animal bone sample reported on in this volume. This will be followed by an attempt to estimate the proportion of the tell's total archaeological assemblage that this sample represents. Next, we provide information about the number of animal bones saved and discarded from within individual excavation areas and squares each season of excavation. Thereafter, some observations will be made about the stratigraphic, chronological, and depositional context of the bone samples. Information about the survival rates of different types of bones will also be provided. The chapter concludes by offering a summary overview of what we have learned about the post-depositional processes responsible for the formation of Tell Hesban's zooarchaeological record.

Excavation Areas on Tell Hesban

The portion of the ancient site of Tell Hesban which was investigated most intensely by archaeologists between 1968 and 1976 was the summit area (see pl. 1.1, above). This summit, which reaches an elevation of over 890 m, is encircled by an undulating landscape consisting of shelves, slopes, ridges and valleys which range in elevation between 700 m and 890 m. Here numerous ancient ruins and large quantities of pottery occur as well. These surrounding ruins are most abundant along a ridge which runs from approximately 600 m north of the summit to 600 m south of it (fig. 3.1).

The decision to excavate primarily in the summit region was based on two principal considerations. The first was that this particular portion of the site was under the control the Department of Antiquities as it contained ruins of substantial monumental buildings from the Roman and Byzantine periods. It had thus been kept from being built upon by the population which recently had settled elsewhere throughout the area of the ancient site. The second was that this summit area was deemed to be the most likely candidate for the location of the ancient biblical town of Heshbon.

The excavation of the summit area was conducted in accordance with the so-called Wheeler-Kenyon Method, which called for careful peeling off of layers of dirt inside the squares (pl. 3.1). Such squares were clustered in four principal excavation areas. These included Area A, which was to probe the top of the summit where the bulk of the Roman and Byzantine monumental building remains were located. Area B was located on a shelf half-way down the southwestern slope of the summit. Its purpose was to uncover remains of domestic dwellings and activities at the site. Area C, which extended downslope from the summit in a northwesterly direction, was intended as a search for any signs of ancient fortification walls. Area D, which climbs up the southeastern slope of the tell,

Figure 3.1 Map of Hesban region.

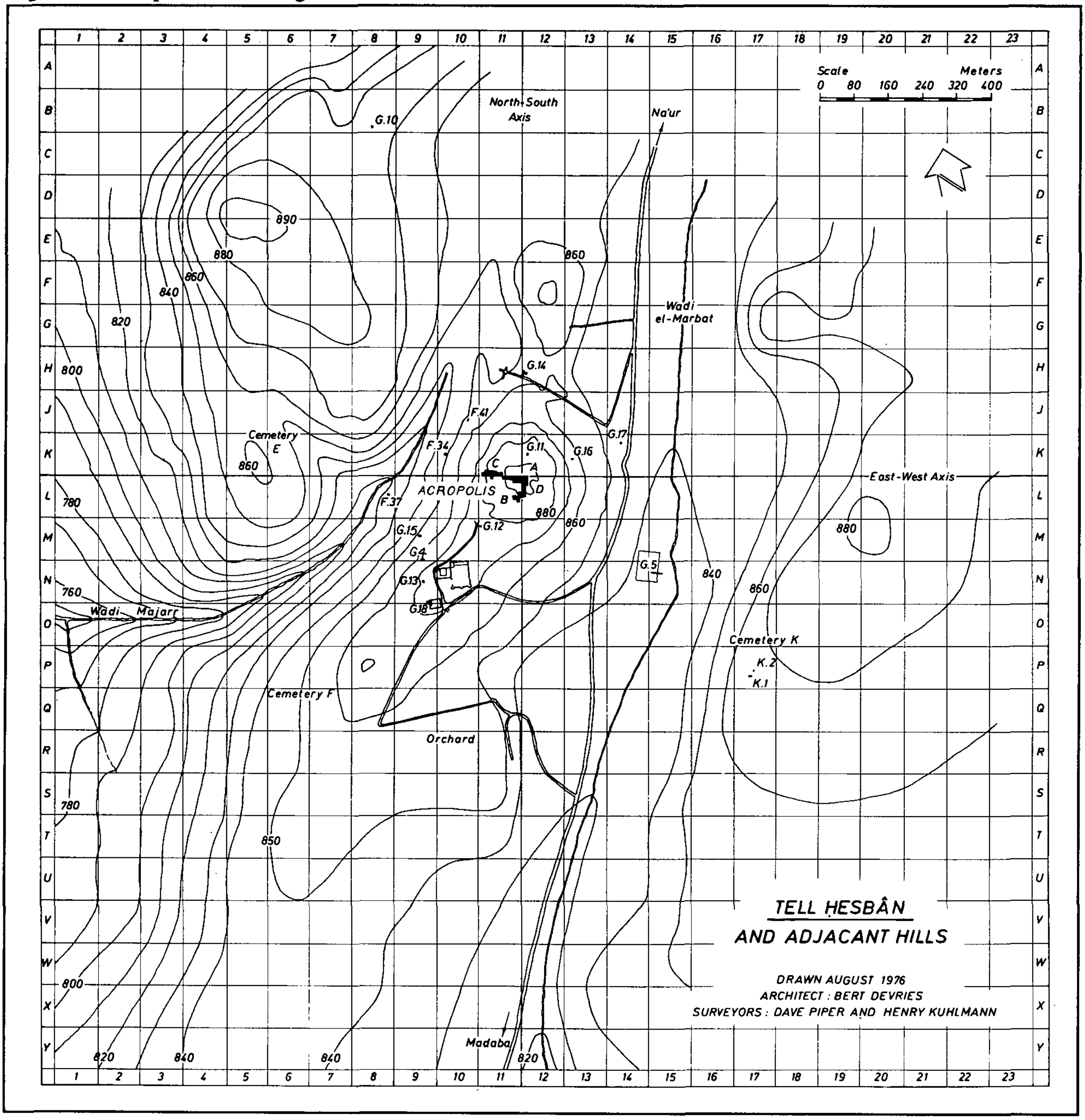


Plate 3.1 Tell Hesban summit excavation areas (1971).

was an attempt to locate the stairs which led up to the acropolis.

The information we have on hand from these excavations consists of field records and computerized data bases describing what was found in some thirty-two different squares on the main tell (Areas A-D), plus similar records from numerous probes in its surroundings (Probes E-G). Find spots within each square were called loci (plural) or locus (singular). A locus consisted of any archaeologically distinguishable feature: a layer of earth with distinguishable texture, or color, or contents; an installation, such as a cistern or a wall; a pit or foundation trench, etc. Pottery, bones and other objects were collected and labeled so that the square it came from, along with its locus and pail of origin was recorded.

The Proportion of the Whole Tell Probed by the Excavations

A rough estimate of the proportion of the summit area which was actually sampled by excavations in Areas A-D can be arrived at by drawing a circle around the tell's summit and by dividing the area within that circle by the area actually excavated. If the circle is drawn so that it includes excavation Areas A-D, its diameter is conveniently 100 m (radius = 50 m). This means that the surface of the summit area inside our circle is 7,850 m^2 ($50 \times 50 \times 3.14$). The excavated surface area of Areas A-D has been determined by Paul J. Ray, Jr., as about 1,535 m^2 (personal communication), or about 20% of the total surface of the summit.

There is one caution which needs to be kept in mind when estimating that about 20% of the site was excavated. This estimate does not reckon with the portion of the site which extends beyond the summit. If this larger region is to be included, and for argument's sake, assuming it consists of the landscape within a diameter of 1,000 m of the summit (radius = 500 m), then the proportion of the site that was excavated represents only about 0.25% of the larger area ($500 \times 500 \times 3.14 =$ 785,000 m^2 divided by the area of Areas A-D, G, about 1,945 m^2; Paul J. Ray, Jr., personal communication).

Bones Saved and Discarded from Different Excavation Areas

A closer look at the quantities of bones excavated in the different areas and squares reveals considerable variation from one deposit to the next. Pertinent data is available from the last four seasons of excavation: 1971, 1973, 1974, and 1976. These data are summarized in table 3.1.

The Stratigraphical and Chronological Context of Animal Bone Deposits

An ultimate goal of any archaeological excavation is to be able to assign all finds from different stratigraphic operations to successive, site-wide stratigraphic and chronological contexts—each context being clearly distinguishable from others

Table 3.1 Bones recovered in different squares over four seasons.

Area	Year								
Square Number	1971 Save	1971 Scrap	1973 Save	1973 Scrap	1974 Save	1974 Scrap	1976 Save	1976 Scrap	Total
A.1	63	0	10	18	0	0	19	9	119
A.2	47	0	0	0	0	0	0	0	47
A.3	7	0	12	16	0	0	0	0	35
A.4	9	0	42	91	0	0	0	0	142
A.5	22	0	27	41	285	810	0	0	1,185
A.6	28	0	242	494	1	0	889	578	2,232
A.7	0	0	1,903	2,893	231	537	33	17	5,614
A.8	0	0	51	74	184	450	650	308	1,717
A.9	0	0	0	0	1,209	1,536	875	478	4,098
A.10	0	0	0	0	0	0	1,866	1,054	2,920
A.11	0	0	0	0	0	0	846	426	1,272
Subtotal	176	0	2,287	3,627	1,910	3,333	5,178	2,870	19,381
B.1	620	0	1,330	2,539	0	0	11	0	4,500
B.2	50	0	691	1,066	815	1,064	1,429	189	5,304
B.3	39	0	258	482	75	103	0	0	957
B.4	214	0	515	753	1,024	1,610	901	278	5,295
B.5	0	0	39	73	0	0	0	0	112
B.6	0	0	44	73	0	0	0	0	117
B.7	0	0	0	0	442	1,000	2,287	1,158	4,887
Subtotal	923	0	2,877	4,986	2,356	3,777	4,628	1,625	21,172
C	0	0	0	0	0	0	18	4	22
C.1	89	0	568	708	500	778	4,320	2,408	9,371
C.2	8	0	1,279	2,026	401	765	0	0	4,479
C.3	4	0	408	394	243	483	20	10	1,562
C.4	359	0	39	232	0	0	31	20	681
C.5	418	0	21	18	469	825	7,414	3,894	13,059
C.6	18	0	0	0	554	1,005	1,358	775	3,710
C.7	0	0	0	0	477	939	996	422	2,834
C.8	0	0	0	0	29	89	2,515	1,433	4,066
C.9	0	0	0	0	0	0	3,622	3,071	6,693
C.10	0	0	0	0	0	0	2,130	1,567	3,697
C.12	0	0	0	0	0	0	24	0	24
C.13	0	0	0	0	0	0	6	4	10
Subtotal	896	0	2,315	3,378	2,673	4,884	22,454	13,608	50,208
D.1	41	0	730	1,630	400	919	0	0	3,720
D.2	0	0	1,006	2,674	1,223	3,050	331	55	8,339
D.3	0	0	369	529	1,531	2,119	372	145	5,065
D.4	0	0	759	1,444	783	1,500	3,077	1,543	9,106
D.5	50	0	46	140	26	44	0	0	306
D.6	705	0	491	808	0	0	0	0	2,004
Subtotal	796	0	3,401	7,225	3,963	7,632	3,780	1,743	28,540
E	0	0	0	0	5	1	0	0	6
Subtotal	0	0	0	0	5	1	0	0	6
F	0	0	0	0	27	21	0	0	48
F.12	0	0	1	0	0	0	0	0	1
F.28	0	0	0	0	0	0	251	250	501
F.30	0	0	0	0	0	0	41	20	61
F.31	0	0	0	0	0	0	0	1	1
F.34	0	0	0	0	0	0	20	3	23
F.35	0	0	0	0	0	0	105	42	147
F.36	0	0	0	0	0	0	28	9	37
F.37	0	0	0	0	0	0	122	44	166
F.38	0	0	0	0	0	0	9	5	14
F.40	0	0	0	0	0	0	1	1	2
F.41	0	0	0	0	0	0	35	15	50
Subtotal	0	0	1	0	27	21	612	390	1,051

Table 3.1, *continued.* Bones recovered in different squares over four seasons.

Area Square Number	Year 1971 Save	1971 Scrap	1973 Save	1973 Scrap	1974 Save	1974 Scrap	1976 Save	1976 Scrap	Total
G	0	0	0	0	29	199	0	0	228
G.1	0	0	263	595	0	0	0	0	858
G.3	0	0	71	67	0	0	0	0	138
G.4	0	0	0	0	0	0	793	323	1,116
G.7	0	0	0	0	4	8	0	0	12
G.9	0	0	0	0	472	913	0	0	1,385
G.11	0	0	0	0	0	0	596	180	776
G.12	0	0	0	0	0	0	829	410	1,239
G.13	0	0	0	0	0	0	114	47	161
G.14	0	0	0	0	0	0	76	52	128
G.15	0	0	0	0	0	0	232	105	337
G.16	0	0	0	0	0	0	111	91	202
G.17	0	0	0	0	0	0	3	2	5
G.18	0	0	0	0	0	0	960	45	141
Subtotal	0	0	334	662	505	1,120	2,958	1,255	6,834
H.4	0	0	0	0	0	0	8	4	12
H.5	0	0	0	0	0	0	24	16	40
Subtotal	0	0	0	0	0	0	32	30	52
J.6	0	0	0	0	0	0	6	0	6
J.8	0	0	0	0	0	0	11	0	11
J.9	0	0	0	0	0	0	13	0	13
J.11	0	0	0	0	0	0	127	11	138
J.12	0	0	0	0	0	0	342	12	354
J.13	0	0	0	0	0	0	300	0	300
Subtotal	0	0	0	0	0	0	799	23	822
Total	2,791	0	11,215	19,878	11,439	20,768	40,441	21,534	128,066

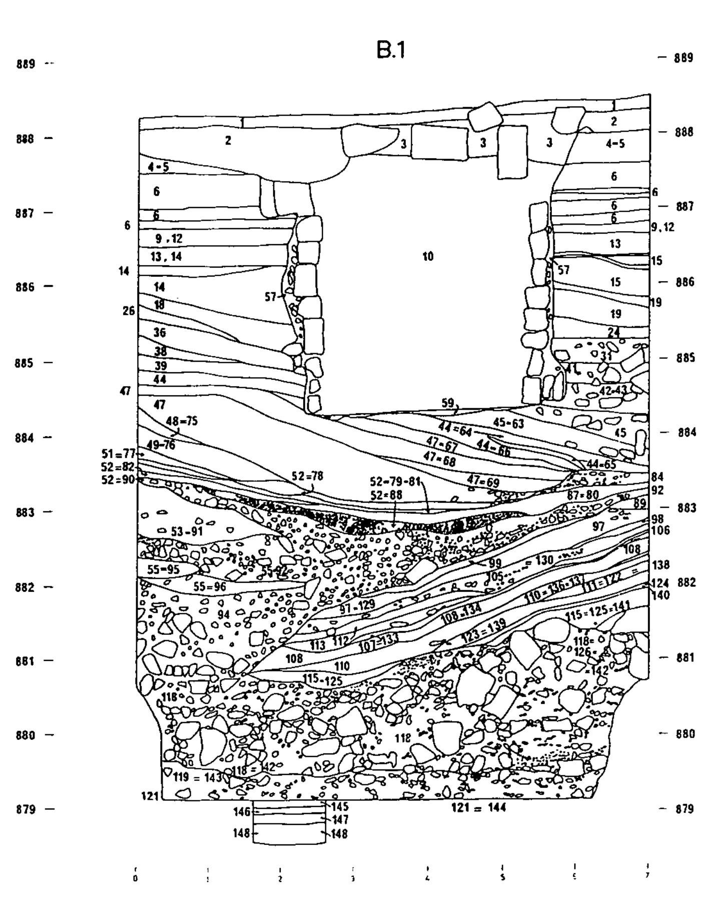
in time and space. Ideally, one would like one's final result to end up being like the proverbial layer cake where layers are stacked neatly one on top of the other. Whether it be a bone fragment or a piece of jewelry, it would then be a simple matter to ascertain what time period it came from by simply checking which layer produced it. The fact is, however, that in reality the situation is usually much more complex, and this is surely the case at Tell Hesban.

To understand the complexity of the stratigraphy of a site such as Tell Hesban, a more helpful analogy than the layer cake might be the marble cake—a loaf cake that is mottled by the use of alternate spoonfuls of light and dark batter. There are layers, of sorts, in a marble cake too, but they are undulating and sometimes interlacing, not flat and distinct as in the layer cake. In the same way, the stratigraphy of Tell Hesban consists of undulating and interlacing layers—some of which are distinguishable site-wide, others which are not. As in the marble cake, many of the layers on the tell are difficult, if not almost impossible, to separate one from the other (fig. 3.2).

Separation of different strata was nevertheless accomplished in the case of Tell Hesban. Thanks to the painstaking care with which the site was dug and recorded, it was possible to separate a total of nineteen archaeological strata. They were separated on the basis of discernable differences from one stratum to the next in either the composition of soil layers and/or their content, such as pottery, objects, or associated installations. In some cases, a particular stratum was attested in all squares dug, in others they were not. Together, they span the history of the tell, starting in the Iron Age and ending with the Modern period. A listing of all nineteen Tell Hesban strata in chronological order is seen in table 3.2.

Dating of strata to specific periods was done by means of analysis of pottery, coins, and other artifacts recovered from each stratum. Of the major

Figure 3.2 Drawing of undulating layers at Hesban.



historical eras represented in the strata from Tell Hesban, the Hellenistic-Roman Era (*ca.* 198 B.C. to A.D. 365) appears to have been the best represented, judging from the assignment of 1,613 loci to strata from this era. Next in the lineup is the Ayyubid-Mamluk period (*ca.* A.D. 1200-1456) with 1292 loci; followed by the Byzantine Era (A.D. 365-661) with 1,175 loci. Very meagerly represented was the Iron Age (*ca.* 1200-500 B.C.) with only 212 loci.

It would be convenient if the chronological context of the bone finds from Tell Hesban was as simple as the above discussion might suggest—if it was really possible to date every bone confidently to one of nineteen strata, or minimally to one of four eras. The truth is that this is by no means always possible. Indeed, the vast majority of the loci containing bones are not "clean," because although they have been assigned a particular period on the basis of dominant pottery content, pottery from other periods is mixed in.

The major reason why there were so few "clean" loci from Tell Hesban is the fact that the site was occupied again and again by different groups of people. Each new group to occupy the site would do its share to disturb the layers of debris laid

Table 3.2 Hesban strata.

Stratum	Number of Loci	Period	Approximate Dates	Approximate Number of Years
1	68	Modern	A.D. 1870-1976	*ca.* 106 years
gap		Ottoman	A.D. 1456-1870	*ca.* 414 years
2	379	Late Mamluk	A.D. 1400-1456	*ca.* 56 years
3	787	Early Mamluk	A.D. 1260-1400	*ca.* 140 years
4	126	Ayyubid	A.D. 1200-1260	*ca.* 60 years
gap		Fatimid	A.D. 969-1200	*ca.* 231 years
5	56	Abbasid	A.D. 750-969	*ca.* 219 years
6	210	Umayyad	A.D. 661-750	*ca.* 84 years
7	55	Late Byzantine	A.D. 614-661	*ca.* 47 years
8	259	Late Byzantine	A.D. 551-614	*ca.* 63 years
9	340	Early Byzantine	A.D. 408-551	*ca.* 143 years
10	255	Early Byzantine	A.D. 365-408	*ca.* 43 years
11	308	Late Roman	A.D. 284-365	*ca.* 81 years
12	199	Late Roman	A.D. 193-284	*ca.* 91 years
13	399	Late Roman	A.D. 130-193	*ca.* 63 years
14	417	Early Roman	63 B.C.-A.D. 130	*ca.* 193 years
15	290	Late Hellenistic	198-63 B.C.	*ca.* 135 years
gap		Late Persian	500-198 B.C.	*ca.* 302 years
16	58	Iron 2	700-500 B.C.	*ca.* 200 years
17	42	Iron 2	900-700 B.C.	*ca.* 200 years
18	30	Iron 2	1150-900 B.C.	*ca.* 250 years
19	82	Iron 1	1200-1150 B.C.	*ca.* 50 years

Table 3.3 Summary of chronological and stratigraphical data.

			Certainty (%)					Interpretation Codes (%) (under 10% not shown)			
STRATUM	LOCI	PERIOD	CERT	PROB	POSS	UNCT	OSSM				
1	6	EBYZ	0	50	17	33	-	Soillay 50	Sealstn 33	Fillay 17%	
	1	EMOD	-	-	100	-	-	Soillay 100			
	1	LMAM	-	100	-	-	-	Balkrem 100			
	55	LO/M	69	31	-	-	-	Sursoil 60	Soillay 24		
	4	MAM	50	50	-	-	-	Soillay 50	Cave 25	Sursoil 25	
	1	MOD	-	-	-	100	-	Soillay 100			
2	77	A/MA	9	65	14	12	-	Soillay 69	Fillay 21		
	1	AM	-	-	-	-	100	Wall 100			
	3	AMA	-	100	-	-	-	Soillay 100			
	1	EBYZ	-	100	-	-	-	Soillay 100			
	1	LROM	-	100	-	-	-	Fillay 100			
	2	UMAY	-	50	50	-	-	Soillay 50	Tumble 50		
	269	MAM	48	50	2	-	-	Soillay 42	Tumble 17	Sursoil 10.4	
3	8	A/AM	25	37.5	37.5	-	-	Soillay 62.5	Fillay 12.5	Pit 12.5	Cistern 12.5
	1	ARAB	-	100	-	-	-	Archfrg 100			
	4	AYYB	-	-	100	-	-	Pit 100			
	1	BMAM	-	100	-	-	-	Soilsur 100			
	741	MAM	53	46	1	-	-	Soillay 26.3	Wall 18.5	Floor 11.2	
4	10	A/MA	20	80	-	-	-	Soillay 100			
	32	AYYB	19	81	-	-	-	Soillay 40.6	Pit 25	Robtren 15.6	
5	50	ABBD	-	64	30	6	-	Soillay 58	Tumble 10		
	1	EBYZ	-	100	-	-	-	Encwall 100			
	2	LROM	-	100	-	-	-	Floor 50	Srcphgs 50		
	1	UMAY	-	-	100	-	-	Fillay 100			
6	201	UMAY	-	59	26	15	-	Soillay 45	Wall 11		
7	20	BYZN	-	70	15	15	-	Soillay 45	Fillay 40		
	1	EBYZ	-	-	100	-	-	Channel 100			
	32	LBYZ	-	46.9	50	3.1	-	Soillay 66			
8	45	BYZN	9	76	13	2	-	Fillay 53	Soillay 13		
	18	EBYZ	-	78	17	6	-	Pubwall 50	Channel 22	Pilbase 11	Pubwall 11
	171	LBYZ	-	63	32	5	-	Soillay 16	Mosaic 13	Ftrench 10	
	5	LROM	-	80	20	-	-	Stywall 40	Pilbase 40	Stywall 20	
9	33	BYZN	12	64	12	12	-	Fillay 67	Burial 18	Soillay 12	
	217	EBYZ	1	72	21	6	-	Soillay 29	Ftrench 12		
	59	LBYZ	-	71	25	3	-	Tumble 39	Soillay 32		
	2	LROM	-	50	50	-	-	Ftrench 50	Pubwall 50		
10	9	BYZN	-	78	11	11	-	Soillay 67	Fillay 22	Burial 11	
	129	EBYZ	-	91	5	4	-	Soillay 62	Huwsurf 23		
	1	LHEL	-	100	-	-	-	Fortwal 100			
11	9	BYZN	-	78	22	-	-	Soillay 56	Burial 22	Fillay 11	Rubblay 11
	71	EBYZ	4	83	6	7	-	Soillay 48	Rubblay 31	Fillay 10	
	11	EROM	-	82	18	-	-	Wall 45	Pubwall 27		
	1	LHEL	-	100	-	-	-	Fortwal 100			
	189	LROM	-	73	23	4	-	Soillay 26	Soilsur 12		
	1	ROMN	-	100	-	-	-	Pubwall 100			
12	19	EROM	-	79	16	5	-	Door 32	Domwall 16	Soillay 11	Wall 11
	164	LROM	4	74	21	1	-	Soillay 33	Fillay 12	Huwsurf 10	
13	278	EROM	-	87	12	1	-	Soillay 36	Fillay 14		
	50	LROM	4	74	20	2	-	Soillay 24	Huwsurf 20	Soilsur 12	
	2	LHEL	-	50	50	-	-	Pubwall 50	Soillay 50		
14	395	EROM	3	79	17	1	-	Soillay 34			
	3	LROM	-	67	33	-	-	Ftrench 33	Soillay 33	Wall 33	
	3	LHEL	-	33	67	-	-	Wall 67	Soillay 33		
15	2	EROM	-	-	-	100	-	Storpit 100			
	149	HELL	-	98	2	-	-	Fill 100			
	2	I2/P	-	-	100	-	-	Fill 100			
	1	IRON	-	-	100	-	-	Cistern 100			
	113	LHELL	-	77	19	4	-	Soillay 41	Stosilo 12		
16	53	I2/P	60	23	17	-	-	Dump 38	Soillay 28	Plaslin 13	
	4	IRN2	-	-	100	-	-	Channel 50	Plaslin 50		
17	3	I2/P	-	33	67	-	-	Plaslin 67	Channel 33		
	35	IRN2	11	51	37	-	-	Dump 51	Bedrock 20	Plaslin 20	
	2	IRN1	50	-	50	-	-	Dump 50	Bedrock 50		
18	6	IRN2	-	100	-	-	-	Dump 100			
	23	IRN1	87	13	-	-	-	Dump 100			
19	16	IRN1	19	81	-	-	-	Dump 19	Wall 19	Cissilt 13	Plaslin 13
20	66	IRN1	88	12	-	-	-	Fill 73	Bedrock 12	Dump 11	

down by earlier occupants. A particularly poignant example is the disturbance which resulted from a major building phase during the Iron II period. What the evidence from Area B suggests is that sometime during the seventh or sixth century B.C. a clean scraping of the acropolis area occurred which resulted in the removal of most traces of earlier occupational debris from on top of the tell. Consequently, most of the earlier Iron I evidence from the site is represented in fill deposits on shelves and slopes below the acropolis and not *in-situ* occupational contexts on the top.

Table 3.3 provides an overview of the predominant chronological and archaeological nature of each of Tell Hesban's nineteen strata. The table gives the number of loci and bones saved in each stratum, the assigned period and the certainty with which each locus was dated to a certain period, and the "interpretation codes" assigned to each. The interpretation codes are listed in order according to frequency of occurrence within the locus list from each stratum.

The Depositional Context of Bones from the 1976 Season

Data on hand from the 1976 season allows us to take a closer look at the precise depositional context of the bone corpus from that season. What makes this possible is that, thanks to the work of Joachim Boessneck and Angela von den Driesch, the contents of every bone bag which came to the bone lab during the 1976 season was weighed. What is presented in table 3.4 are the combined weights of bones of different species of mammals found in different contexts (as indicated by interpretation codes). They are listed in order by weight (in grams).

What this table shows is that over 52% of the bone material recovered during the 1976 season came from fill and dump deposits. Another 18% came from soil layers and huwwar surfaces. The left-over 30% came from the remaining two dozen different depositional contexts. Incidentally, it might be noted that the mean weight of an individual bone fragment from Tell Hesban in 1976 was only a little over 3 grams (58,319 gr ÷ 18,627 bones = 3.13 gr).

Table 3.4 Depositional contexts of 1976 season's bones.

Context	Weight
Fill	17,040 gr
Dump	13,460 gr
Soil layer	6,245 gr
Huwwar surface	4,322 gr
Plaster surface	3,427 gr
Cave	2,253 gr
Cleanup	1,872 gr
Soil surface	1,778 gr
Foundation trench	1,748 gr
Balk trim	1,040 gr
Tumble	998 gr
Rubble layer	885 gr
Foundation	617 gr
Cobble surface	569 gr
Fill layer	414 gr
Floor	407 gr
Robber trench	351 gr
Storage silo	333 gr
Wall	318 gr
Balk trim	200 gr
Pit	171 gr
Mosaic	156 gr
Occupational surface	55 gr
Possible wall	23 gr
Bedrock	20 gr
Stairway	17 gr
Gravel layer	4 gr
Huwwar layer	3 gr
Total	58,319 gr

Survival Rates of Different Skeletal Parts

In the previous chapter it was noted that the animal bones which end up becoming a part of the archaeological record are extremely few when compared with how many animals are slaughtered and killed at a site such as ours in the course of a year or a generation. On the basis of a taphonomic survey of skeletal parts found on the ground in and around the present-day village of Hesban, it was determined that on average less than 2% of the bones which are discarded by humans and scavenging animals end up becoming candidates for the archaeological record (see chapter 2). These, it was noted, tend to be the most robust portions of the animals' skeletons. The evidence also suggested that the bones of larger animals are more likely to become a part of this record than those of smaller ones.

Examination of the survival rates of different skeletal parts in the bone assemblage from the excavations on the tell lend partial support to these

Table 3.5 Most common bones in 1976 season's bone assemblage.

Species	Bone Type	Number	Percent
cattle	N =	2,379	
	Rib	563	23.66%
	Mandible	130	5.46%
	Radius	118	4.96%
	Tibia	117	4.92%
	Neurocranium	114	4.79%
	Percent of N =		43.79%
camel	N =	300	
	Rib	74	24.66%
	Tibia	24	8.00%
	Thoracic vert.	22	7.33%
	Lumbar vert.	21	7.00%
	Radius	19	6.33%
	Percent of N =		53.32%
sheep/ goat	N =	14,911	
	Rib	2,968	19.90%
	Tibia	1,504	10.08%
	Femur	1,233	8.26%
	Humerus	966	6.48%
	Mandible	903	6.06%
	Percent of N =		50.78%
pig	N =	733	
	Rib	140	19.10%
	Mandible	94	12.82%
	Neurocranium	82	11.19%
	Scapula	51	6.96%
	Metapodial	45	6.14%
	Percent of N =		56.21%

observations. Such support is found, for example, in the data presented in table 3.5 which lists the most frequently represented bones of cattle, camel, sheep/goat, and pig.

Noteworthy about the data presented in this table is the fact that in the case of camel, sheep/goat, and pig the five most common bones make up over 50% of the bones representing them. In the case of cattle, they contribute 43%. Of the five most common bones, ribs top the list. They are followed by mandibles and tibia bones.

Unexpected, on the basis of the taphonomic survey findings, are the survival rates for ribs, as very few were picked up in the course of the survey. As will be discussed in further detail in chapter 4, the major reason for this is the protective environments provided by the numerous cisterns on Tell Hesban. Noteworthy, also, is the survival of significant numbers of neurocranium fragments of cattle and pigs. This is not surprising, however, as in both species, the neurocranium is a very robust portion of the skeleton—much more so than in sheep or goats.

Mention must also be made of the fact that over 800 chicken bones were recovered in the excavations. These came primarily from the most recent strata where they had been preserved for posterity in the bottom of numerous cisterns.

Conclusions: Post-depositional Processes at Tell Hesban

In the foregoing pages, an overview has been presented of the archaeological context of the animal bone assemblage from Tell Hesban. An idea has been provided of the nature of the stratigraphy of the tell—it was suggested that its appearance is more like the jumbled, undulating layers of a marble cake than the neat horizontal bands of a layer cake. Where and how the animal bones were collected was also discussed, as was their stratigraphical, chronological, and depositional contexts. Evidence was presented which suggests that most of the animal bones uncovered came from fill deposits, dumps, soil layers, huwwar, and plaster surfaces.

Now that the myth of the layer cake with its neatly ordered deposits has been shattered, it remains to comment on the implications of this for attempts to generalize about changes in the composition of the bone finds from one stratum to the next. The following points will be noted.

First, the fact that the site's stratigraphy—as delineated by means of computer-assisted analysis of loci from all over the tell—is as complex as it is, is grounds for confidence that the layers have both stratigraphic and chronological validity. The temptation to impose a layer-cake order has clearly been resisted in favor of tracing the layers in their actual, undulating and erratic paths across the tell.

Second, the presence in most strata of clearly predominant assemblages of pottery by means of which each stratum could be dated adds further to the impression that there is integrity to the proposed stratigraphic schema. The fact that these predominant pottery assemblages are also associated with numerous other objects and installations, many of which provide corroborating dating evidence, is also noteworthy.

Third, it is reasonable to assume that to the extent that the proposed delineation of layers has stratigraphic and chronological validity, so do their associated bone deposits. It would also seem reasonable, therefore, to assume that the vast majority of the bones found in a particular stratum truly belong to that stratum—*i.e.*, they became a part of the archaeological record during the centuries that particular stratum was built up.

Fourth, as will be noted in subsequent chapters, this assumption is supported by the bone evidence itself. The changes which have been documented in the composition of different species "makes sense" in terms of what we might expect, given our knowledge of the history and culture of this region throughout antiquity.

Fifth, to the extent that post-depositional disturbance did occur, it was likely due primarily to transport from one stratum to another by rodents and reptiles inhabiting the tell's strata. As will be explained in subsequent chapters, such transport did occur, but its impact was likely minimal, judging from relatively uncommon occurrence of signs of burrowing in the excavated layers.

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Chapter Four

THE EFFECT OF POST-DEPOSITIONAL CONTEXTS ON THE PRESERVATION AND INTERPRETATION OF BONE SAMPLES: A CASE STUDY

Øystein Sakala LaBianca

Chapter Four

The Effect of Post-depositional Contexts on the Preservation and Interpretation of Bone Samples: A Case Study

Introduction

In the previous chapter we offered an overview of the "macro-context" of Tell Hesban's zooarchaeological record. Information was provided about where the bones came from on the tell and about the chronological and depositional context of each of its successive strata. In this chapter we leave behind site-wide generalizations such as was presented in chapter 3 and take instead a closer look at particular "micro-contexts." By this term I mean deposits which are limited in space and time to particular analytically distinguishable locations and periods.

What originally spurred our interest in post-depositional processes and micro-contexts was the uncertainty which prevailed during the fieldwork phase of the Heshbon Expedition about the chronological and stratigraphical context of the vast majority of the bone deposits. As no site-wide stratigraphic schema was available until after the last summer of fieldwork (Sauer 1978), attempts at the end of each season to order the bone finds into some sort of chronological sequence proved futile. The only way to come up with any sort of samples that could be relied upon for specialized analytical treatment, therefore, was to limit post-season analysis throughout the fieldwork phase to small sub-sets of bones from particular micro-contexts.

Between 1971 and 1976, we undertook analysis of bones from several different micro-contexts. The first—which is published herewith—involved two bone samples recovered during the 1971 field season (LaBianca 1973). The second dealt with samples collected in 1973 from four different deposits dating to the Hellenistic and Roman periods (LaBianca and LaBianca 1975). The third concerned bones recovered in 1974 from a single Early Roman period deposit (LaBianca and LaBianca 1976).

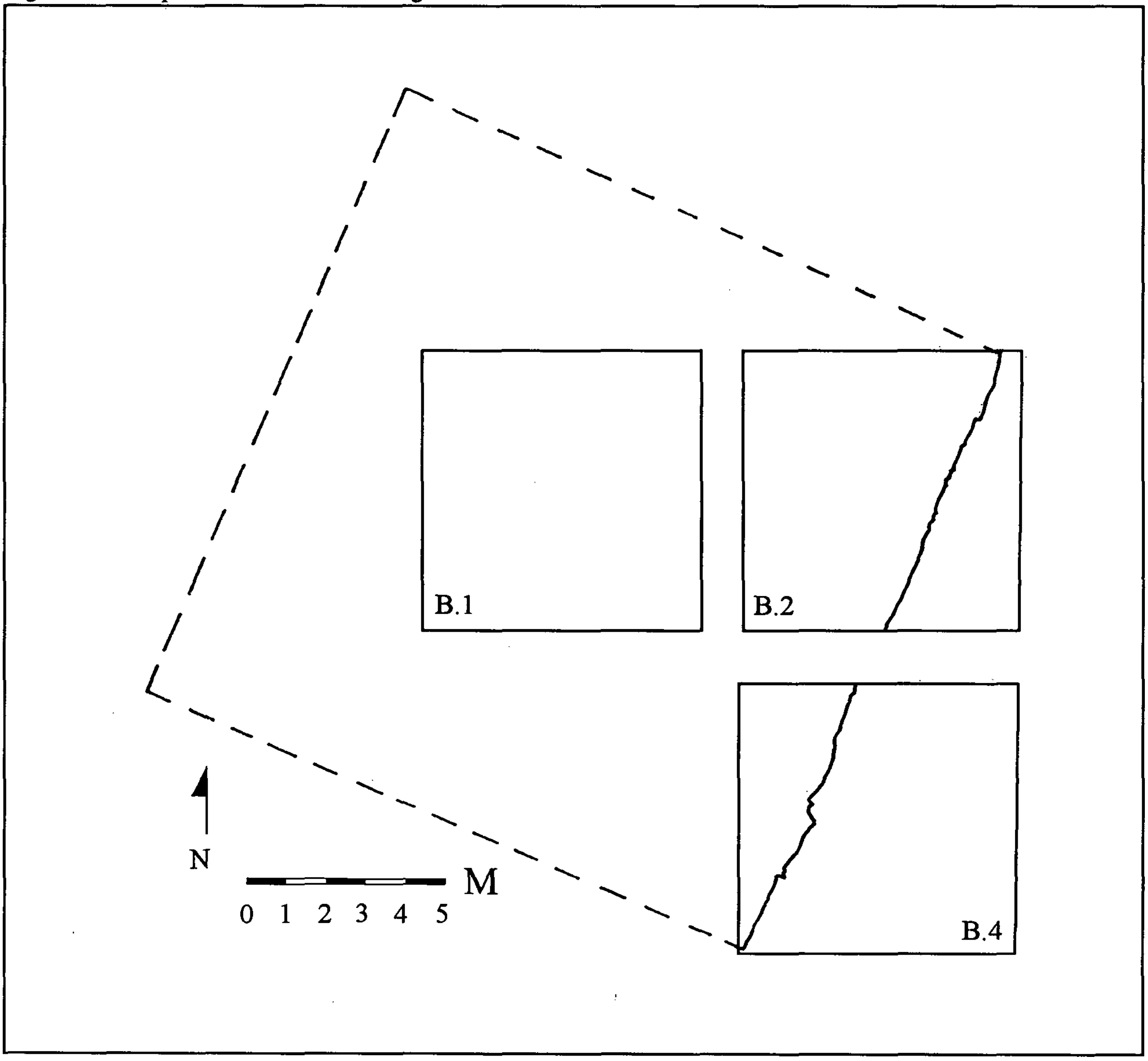
Our aim in including the present chapter is to provide an example of the sorts of insights that can be gained from studies of micro-contexts. Specifically, the chapter will address two questions. One, to what extent do different post-depositional contexts impact the preservation of bone samples? Two, to what extent do such micro-contexts impact our ability to recognize cultural patterning in bone samples? In other words, does cultural patterning "shine through" despite differences in preservation of bones due to post-depositional disturbance?

To answer these questions we begin by offering a brief description of the two deposits that produced the bone samples examined here. This is followed by comparisons of the two samples with regard to first, evidence of post-depositional disturbance of various skeletal parts and, second, evidence of cultural patterning. The latter includes an attempt to interpret the data on sheep/goat ratios, sex ratios, and age ratios in the light of explicit theory about the difference between husbandry and herding as strategies for exploiting animals. The chapter concludes by reflecting on the implications of micro- and macro-contextual approaches for the future of tell archaeology.

The Two Micro-contexts

As indicated earlier, the bone samples which are analyzed in this chapter were collected in 1971, during the second field season at Tell Hesban. During that season, a total of 2,791 bones were saved out of an estimated 22,000 recovered fragments. Of these that were saved, we focus here on a sample of 701 bones of sheep and goats, of which 310 came from Square B.1., an Iron Age

Figure 4.1 Proposed area of the Iron Age reservoir in Area B.

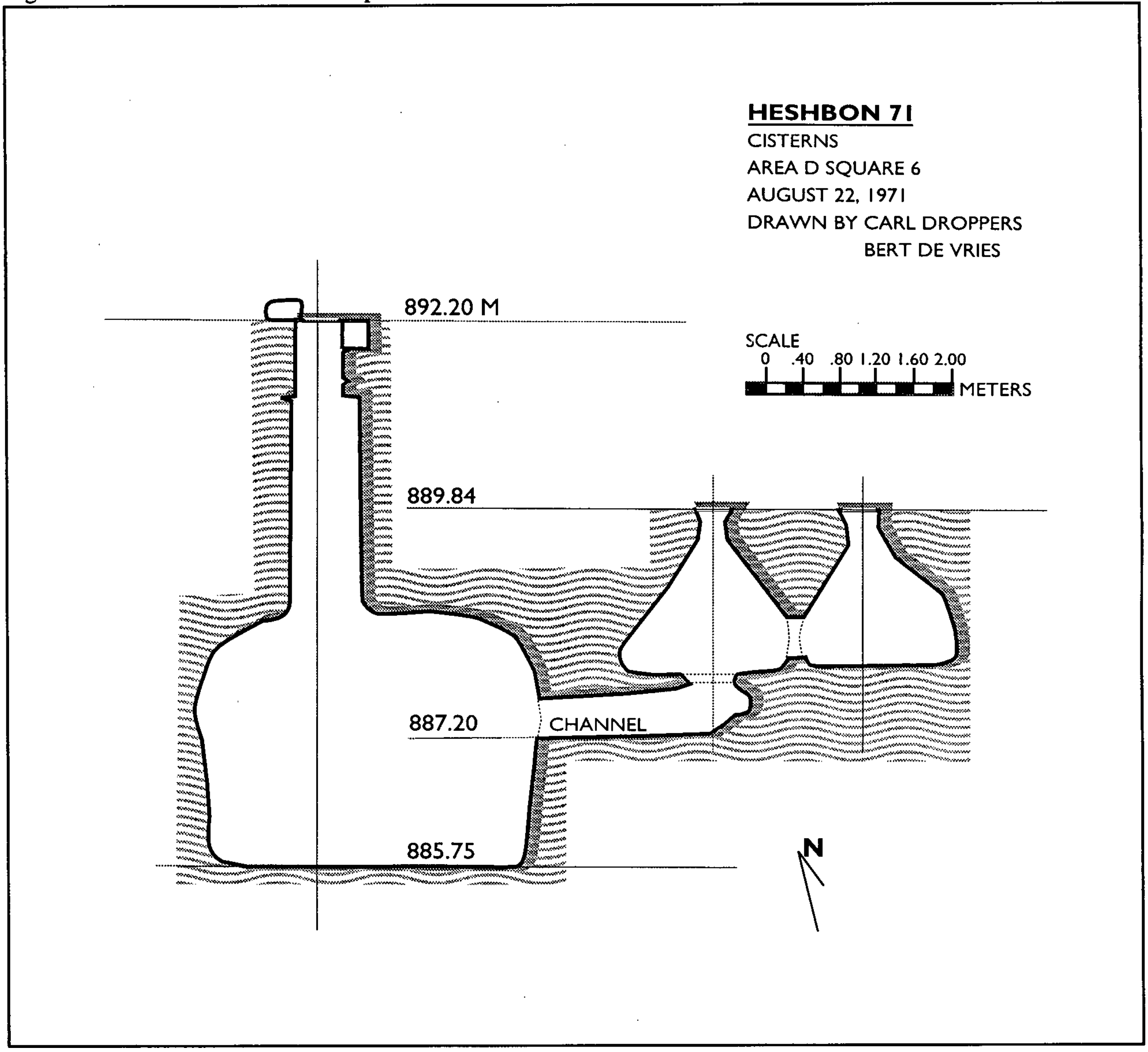


reservoir (fig. 4.1), and 391 came from D.6:33, a cistern (fig. 4.2). Henceforth, we shall refer to the sample from the B.1 reservoir as simply the "B.1 sample" or the "reservoir sample"; and to the sample from the D.6:33 cistern as simply the "D.6 sample" or the "cistern sample."

While both of the samples were recovered from inside installations, the archaeological evidence seems to indicate two rather different post-depositional impacts as far as preservation of the bones is concerned. In general, the evidence suggests that the bones from the cistern sample were better protected and preserved than those from the reservoir sample. While the former assemblage appears to have accumulated gradually over time, the latter seems to have accumulated less smoothly—having originally been deposited on top of the ground, then later being scraped into the reservoir.

According to Jim Sauer who excavated the B.1 sample, the bones came from "a massive fill"—a single stratum consisting of "interlensing but distinct layers of soil and rock tumble" (1973: 69, 70) Some uncertainty exists regarding exactly how this

Figure 4.2 Section of cisterns in Square D.6.



fill originated. On the one hand, Larry Herr (1979) has argued that all of it was scraped into the reservoir in a single, massive leveling operation on top of the tell sometime in the seventh-sixth century B.C. Jim Sauer (1973: 70), on the other hand, feels that only the upper layers of the stratum were thus accumulated. In any case, there seems to be agreement that the fill in question represents a secondary, or even a tertiary, deposit of some sort.

The cistern in D.6 belonged to a Roman water collection complex consisting of three interconnected cisterns—one large, and two smaller ones. According to Larry Geraty, who excavated it, the animal bones came from a 2.0 m high, 6.0 m wide dirt pile at the bottom of the large cistern (1973: 101). While the cistern itself was judged to have been constructed sometime during the Roman period, its dirt contents belonged to a later era, namely the Ayyubid-Mamluk period. The inference that the dirt had accumulated gradually over several decades, and even centuries of use, is supported by stratigraphic evidence for two use phases—the first represented in the lower layers of the dirt pile, the second in its upper layers (Geraty

1973: 101-103). Both phases contributed bones to the sample.

Evidences of Post-depositional Disturbance

In comparing the bone samples from these two micro-contexts, we shall begin by looking at recovery rates of different skeletal parts. In doing so, our aim is to discover differences between the two contexts in the degree to which the bone samples which they produced were subject to post-depositional disturbance. To this end, we shall pay particular attention to differences having to do with preservation of unbroken bones and thin-walled, cancellous parts of the skeleton.

Recovery rates (R) were calculated using the formula R = r/e; where, r = the actual number of individual skeletal elements recovered, e = the number of elements expected based on the assumption that an estimated minimum number of individuals are represented by the skeletal part that is most numerous in the sample. Table 4.1 presents the recovery rates for the different skeletal parts from the two samples. Figure 4.3 highlights the relative difference in recovery rates between the two samples.

We shall begin by noting differences between the two samples when it comes to preservation of complete or unbroken longbones of sheep/goats. Whereas in the cistern sample complete or unbroken bones were found to make up 5.89% of the total number of skeletal elements, in the reservoir sample they only contributed 0.71%. Furthermore, while in the reservoir sample there are only two varieties of complete elements (left complete radius and right complete metacarpus), in the cistern sample there are eight (right and left complete radius, metacarpus, tibia, and metatarsus). The mean recovery rates for complete skeletal elements from the reservoir sample is 3.45%, and from the cistern sample, 11.50%. These data point, we would argue, to a significant difference between the two micro-contexts when it comes to preservation of bone samples.

Differences between the two samples in the preservation of cancellous, thin-walled bones provides additional support for the above conclusion. According to Guilday (1971: 26), examples of thin-walled and cancellous bones include the distal radius, proximal, and distal femur, and the proximal tibia. Thick-walled bones, on the other hand, include the distal humerus, proximal radius, pelvis, calcaneus, and talus. Whereas in the case of the cistern sample the mean recovery rate for thin-walled, cancellous bones is 48.00%, in the reservoir sample the mean recovery rate for such fragments was only 6.25%. These data clearly indicate better preservation of animal bones in the cistern context than in the reservoir context.

Evidence for Cultural Patterning

To what extent, then, does cultural patterning "shine through" despite these differences in the degree to which the bone samples were disturbed and preserved in their respective post-depositional contexts? To answer this question we shall take a look at several different indicators of cultural patterning in animal bones, such as data regarding the ratio of sheep to goats, the ratio of males to females, the ratio of young to old animals, patterns of cut marks stemming from butchering practices, and ratios of meat-rich to meat-poor bones.

The Ratio of Sheep to Goats

The relative importance of sheep and goats can be inferred from analysis of the raw counts of sheep and goat skeletal elements. Table 4.2 shows raw counts of skeletal elements of sheep and goats identified. In addition, it shows the number of elements for which more precise species identification was too difficult as well as the relative degree, expressed in percentages, to which species identification was possible for each element. (The UNSPECIFIED columns contain raw counts of those bones for which separation was not attempted. The % columns contain percentages expressing the extent to which separation was possible for each element.)

In the reservoir sample, 99 bones of sheep and 52 bones of goat were identified. Together, these represent 50.65% of the total number of sheep/goat bones from this context (310). In the cistern sample, 98 bones of sheep and 67 bones of goat were identified. Together, these represent only 42.17% of the total number of bones from that context (391). Whereas 100% identification was

Table 4.1 Recovery rates of sheep/goat skeletal elements from Square B.1 and Cistern D.6:33.

ELEMENT	B.1 MN = 29 (based on l. scapula)			D.6:33 MN = 25 (based on r. female pelvis)		
	e	r	%	e	r	%
male atlas	29	3	10.34	25	1	4.00
female atlas	29	2	6.90	25	2	8.00
axis	29	12	41.38	25	5	20.00
r. scapula	29	21	72.41	25	23	92.00
l. scapula	29	29	100.00	25	24	96.00
r. prox. humerus	-	-	-	25	1	4.00
l. prox. humerus	-	-	-	25	6	24.00
r. dist. humerus	29	25	86.21	25	20	80.00
l. dist. humerus	29	24	82.76	25	16	64.00
r. prox. radius	29	6	20.69	25	10	40.00
l. prox. radius	29	13	44.83	25	5	20.00
r. dist. radius	29	4	13.79	25	7	28.00
l. dist. radius	29	1	3.45	25	13	52.00
r. comp. radius	-	-	-	25	5	20.00
l. comp. radius	29	1	3.45	25	6	24.00
r. ulna	29	1	3.45	25	5	20.00
l. ulna	29	1	3.45	25	12	48.00
r. attached ulna	29	3	10.34	25	7	28.00
l. attached ulna	29	5	17.24	25	6	24.00
r. prox. metacarpus	29	4	13.79	25	2	8.00
l. prox. metacarpus	-	-	-	25	5	20.00
r. dist. metacarpus	29	1	3.45	-	-	-
l. dist. metacarpus	29	5	17.24	25	2	8.00
r. comp. metacarpus	29	1	3.45	25	2	8.00
l. comp. metacarpus	-	-	-	25	1	4.00
r. pelvis	29	14	48.28	25	6	24.00
l. pelvis	29	17	58.62	25	22	88.00
r. female pelvis	29	10	34.48	25	25	100.00
l. female pelvis	29	5	17.24	25	21	84.00
r. male pelvis	29	1	3.45	-	-	-
l. male pelvis	29	3	10.34	-	-	-
r. prox. femur	-	-	-	25	13	52.00
l. prox. femur	29	1	3.45	25	14	56.00
r. dist. femur	29	2	6.90	25	18	72.00
l. dist. femur	29	5	17.24	25	9	36.00
r. calcaneus	29	3	10.34	25	6	24.00
l. calcaneus	29	8	27.59	25	7	28.00
r. talus	29	3	10.34	25	5	20.00
l. talus	29	2	6.90	25	5	20.00
r. prox. tibia	29	4	13.79	25	21	84.00
l. prox. tibia	29	4	13.79	25	5	20.00
r. dist. tibia	29	16	55.17	25	7	28.00
l. dist. tibia	29	9	31.03	25	12	48.00
r. comp. tibia	-	-	-	25	3	12.00
l. comp. tibia	-	-	-	25	2	8.00
r. prox. metatarsus	29	3	10.34	25	3	12.00
l. prox. metatarsus	29	4	13.79	25	3	12.00
r. dist. metatarsus	29	1	3.45	25	1	4.00
l. dist. metatarsus	29	4	13.79	-	-	-
r. comp. metatarsus	-	-	-	25	2	8.00
l. comp. metatarsus	-	-	-	25	2	8.00
phalanx 1	232	27	11.64	200	12	6.25
phalanx 2	232	2	0.86	200	5	2.60
TOTAL	-	310	971.44	-	391	1560.85
	mean recovery rate for B.1 = 22.59; n = 43			mean recovery rate for D.6:33 = 31.85; n = 49		

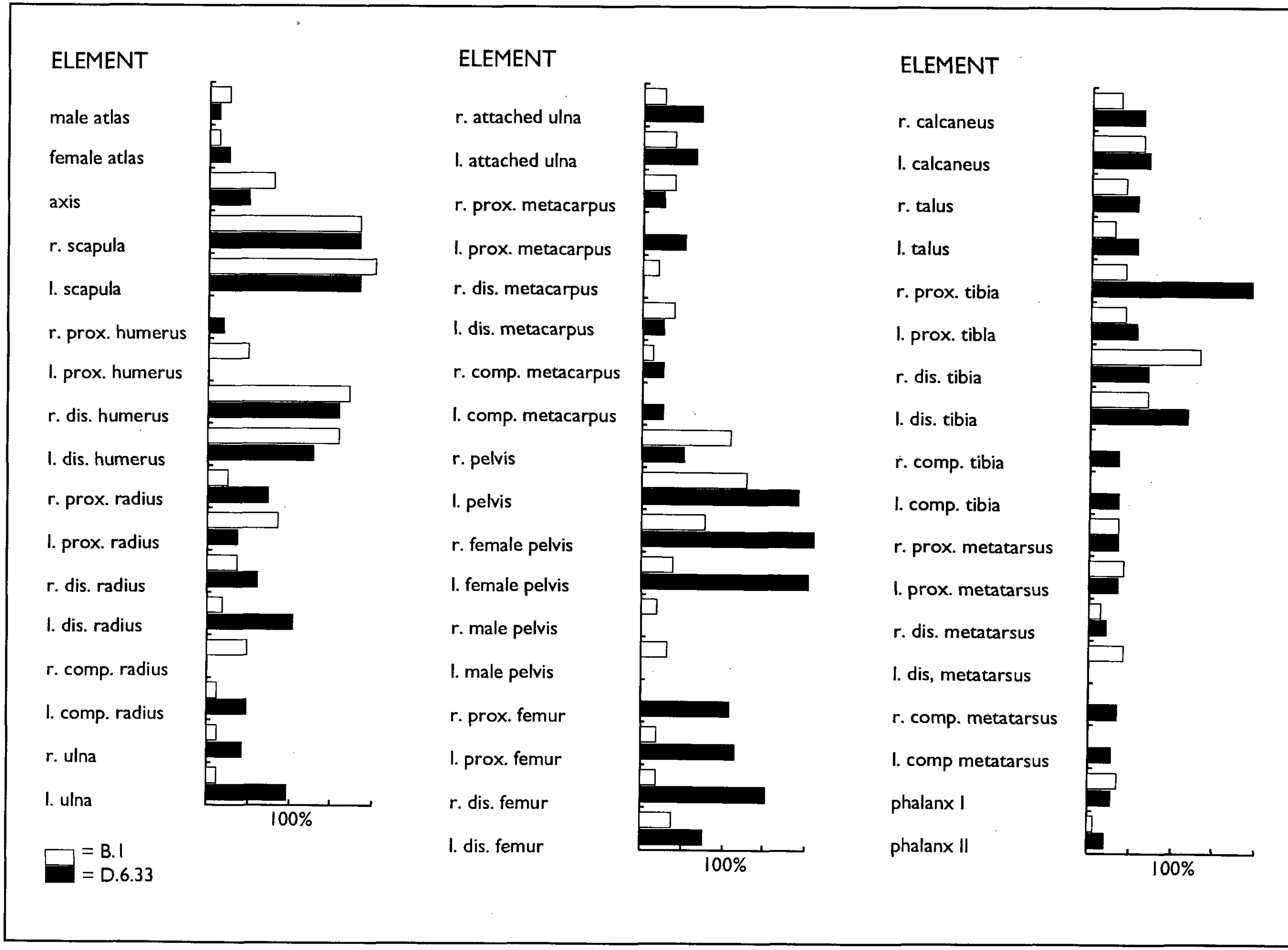


Figure 4.3 Relative differences between recovery rates of sheep/goat skeletal elements.

Table 4.2 Raw counts of skeletal elements of sheep/goats from Square B.1 and Cistern D.6:33.

ELEMENT	SHEEP		GOAT		UNSPECIFIED		PERCENT	
	B.1	D.6	B.1	D.6	B.1	D.6	B.1	D.6
male atlas	3	-	-	1	-	-	100	100
female atlas	2	1	-	1	-	-	100	100
axis	5	2	6	1	1	2	91	60
r. scapula	-	-	-	-	21	23	0	0
l. scapula	-	-	-	-	29	24	0	0
r. prox. humerus	-	-	-	-	-	1	-	0
l. prox. humerus	-	-	-	-	-	6	-	0
r. dist. humerus	10	7	5	5	10	8	60	60
l. dist. humerus	11	4	5	3	8	9	67	43
r. prox. radius	4	5	2	3	-	2	100	80
l. prox. radius	7	3	6	2	-	-	100	100
r. dist. radius	1	2	1	3	2	2	50	71
l. dist. radius	1	4	-	1	-	8	100	38
r. comp. radius	-	2	-	-	-	3	-	40
l. comp. radius	1	3	-	2	-	1	100	84
r. ulna	-	-	-	-	1	5	0	0
l. ulna	-	-	-	-	1	12	0	0
r. attached ulna	-	-	2	6	1	1	67	86
l. attached ulna	1	2	4	2	-	2	100	67
r. prox. metacarpus	4	-	-	-	-	2	100	0
l. prox. metacarpus	-	1	-	-	-	4	-	20
r. dist. metacarpus	1	-	-	-	-	-	100	-
l. dist. metacarpus	5	2	-	-	-	-	100	100
r. comp. metacarpus	-	2	1	-	-	-	100	100
l. comp. metacarpus	-	1	-	-	-	-	-	100
r. pelvis	-	-	-	-	14	6	0	0
l. pelvis	-	-	-	-	17	22	0	0
r. female pelvis	4	9	5	11	1	5	90	80
l. female pelvis	3	4	1	6	1	1	80	91
r. male pelvis	1	-	-	-	-	-	100	-
l. male pelvis	3	-	-	-	-	-	100	-
r. prox. femur	-	6	-	-	-	7	-	46
l. prox. femur	-	5	-	3	1	6	0	57
r. dist. femur	-	-	-	-	2	18	0	0
l. dist. femur	-	-	-	-	5	9	0	0
r. calcaneus	2	3	-	-	1	3	67	50
l. calcaneus	4	3	1	1	3	3	62	67
r. talus	1	4	1	1	1	-	100	100
l. talus	2	2	-	3	-	-	100	100
r. prox. tibia	2	5	2	4	-	12	100	43
l. prox. tibia	3	-	-	2	1	3	75	40
r. dist. tibia	8	4	6	2	2	1	87	86
l. dist. tibia	5	3	2	1	2	8	78	33
r. comp. tibia	-	-	-	1	-	2	-	33
l. comp. tibia	-	1	-	-	-	1	-	50
r. prox. metatarsus	-	-	-	-	3	3	0	0
l. prox. metatarsus	-	-	-	-	4	3	0	0
r. dist. metatarsus	1	-	-	1	-	-	100	100
l. dist. metatarsus	2	-	2	-	-	-	100	-
r. comp. metatarsus	-	1	-	1	-	-	-	100
l. comp. metatarsus	-	2	-	-	-	-	-	100
phalanx 1	-	-	-	-	27	12	0	0
phalanx 2	2	5	-	-	-	-	100	100

possible for 18 elements from the reservoir sample, only 12 elements from the cistern sample could be identified at this rate. The bones for which 100% identification was possible in both samples were male and female atlas, left proximal radius, left distal metacarpal, right complete metacarpal, left talus, right distal metatarsal, and phalanx 2.

In the case of 8 elements, species identification was not attempted. These include right and left scapula, distal femur, proximal metatarsus and first phalanges. This group constitutes 40% of the entire sample from B.1, and 35.04% of the entire sample from D.6:33. Due to the above factors, inferences about the relative importance of sheep and goats are likely to be more accurate for the reservoir sample than for the cistern sample.

Figure 4.4 illustrates the difference between raw scores of counts of identified sheep and goat skeletal elements. Of the 38 skeletal elements for which species identification was possible, the cistern sample has a better representation of each type of skeletal element of sheep and goat than the reservoir sample (34:30). Furthermore, the latter sample has a greater variance in the number of different kinds of sheep *versus* goat elements identified (24:16) than the former (28:24).

The relative importance of sheep and goats in the two samples can be expressed by the approximate ratio 16:9 for the reservoir sample and by the approximate ratio 16:11 for the cistern sample. This would indicate that the importance of sheep was greater for the Iron Age reservoir sample than for the Ayyubid-Mamluk cistern sample.

The Ratio of Males to Females

Atlas and pelvis of sheep/goats from the two samples were studied so as to determine the sex of the animals. The results of these examinations are included in table 4.1 (above).

It is difficult to establish with any degree of certainty the ratio of male to female with samples as comparatively small as these. The number of bones sexed from the reservoir sample was 24. This figure represents 7.74% of the entire sample. The number of bones sexed from the cistern sample was 39, or 10%.

Suggested sex ratios will probably be more reliable for the cistern sample than for the reservoir sample for the following reasons. First, in the case of the cistern sample 56% of the total number of pelves recovered were sexed (36 out of 64), whereas in the case of the reservoir sample, only 38% could be sexed (19 out of 50). Second, the percentage of bones sexed from the cistern sample was greater than for the reservoir sample.

Sex ratios were estimated using two different methods—on the basis of the number of sexed elements and on the basis of minimum number of individuals. Calculations based on the number of sexed elements yielded the following ratios: B.1 reservoir = 17 females to 7 males; D.6 cistern = 38 females to 1 male.

Calculations based on the minimum number of individuals represented in each of the samples of sexed skeletal elements yielded these ratios: 10:3 for the reservoir sample and 25:1 for the cistern sample. Using either method, the apparent dominance of females over males in the cistern sample is obvious. It is clear that females dominate the group in the reservoir sample as well, but to a much lesser extent than in the cistern sample. When the results of these two sets of calculations are combined, the following mean ratios result: 13:5 for the reservoir sample and 32:1 for the cistern sample.

Percentages of Young and Old Animals

The age at which sheep and goats were killed can be estimated from post-cranial remains by studying rates of fusion of the epiphyses. To this end, skeletal elements must be divided into five groups (A-E below) according to the nearest half year at which the epiphysis fuses.

> Bones of Group A (proximal radius, distal humerus, tubercle of the scapula, and the main bones of the innominate) all fuse within the first year of life. Bones of Group B (the first and second phalanges), fuse between one year and a year-and-a-half. Group C (the distal tibia) fuses at about two years. Group D (the distal metapodials) fuses at a point between two and two-and-a-half years. Bones of Group E (the proximal and distal femur, distal radius, and proximal tibia) are all fused by approximately three years of age (Hole, Flannery, Neely (1969: 284).

Tables 4.3 and 4.4 present the data on fusion for different groups of bones from the two samples. Of the bones fusing within the first year (Group A) 86% showed fusion in the reservoir sample and 74% in the cistern sample. After about 1.5 years (Group B), 83% show fusion in the reservoir sample and 81% in cistern sample. After

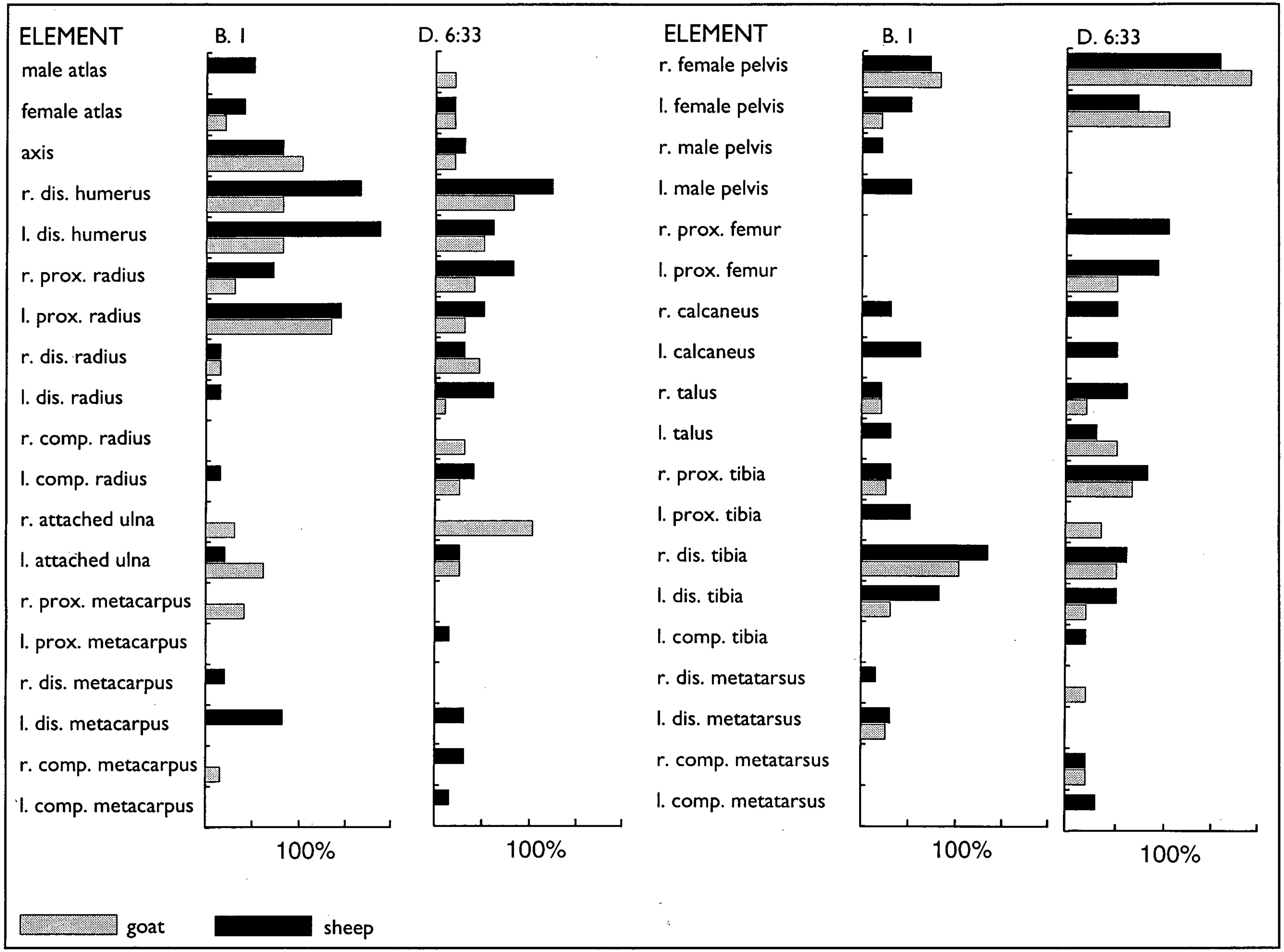


Figure 4.4 Relative differences between raw scores of counts of identified sheep/goat elements from Square B.1 and Cistern D.6:33.

Table 4.3 Counts of fused vs. unfused epiphyses among sheep/goats from Square B.1 and Cistern D.6:33; (N/A = "Not Applicable").

GROUP	ELEMENT	B.1 Fused	B.1 Unfused	B.1 N/A	D.6:33 Fused	D.6:33 Unfused	D.6:33 N/A
Group A: (epiphyses fusing within 1 year)	prox. radius	20	0	0	22	4	0
	dist. humerus	38	2	9	22	7	7
	scapula (tuber.)	24	12	15	28	12	6
	pelvis	31	5	16	34	14	17
Group B: (epiphyses fusing after about 1.5 years)	phalanx 1	23	5	0	8	3	0
	phalanx 2	2	0	0	5	0	0
Group C: (epiphyses fusing after about 2 years)	dist. tibia	20	5	0	12	13	0
Group D: (epiphyses fusing after about 2.5 years)	dist. metapodial	7	5	0	4	10	0
Group E: (epiphyses fusing at about 3-3.5 years)	prox. femur	1	0	0	13	14	0
	dist. femur	3	4	0	8	20	0
	dist. radius	5	1	0	12	22	0
	prox. tibia	6	2	1	9	22	1

about 2 years (Group C), 80% still showed fusion in the reservoir sample whereas only 48% did so in the cistern sample. Beyond about 2.5 years the percentages of fused epiphysis reached the low mark for both samples, 58% for the reservoir sample and 28% for the cistern sample. There is an increase in the number of epiphyses fusing after about 3-3.5 years for both samples, the reservoir sample showing 68% and the cistern sample 35%.

Figure 4.5 illustrates the survival curves for sheep and goats. The curve for the reservoir sample shows that 80% of the animals from that context would be likely to reach an age of at least 2 years, while the cistern sample indicates that the animals from that context had only a 48% chance of reaching that same age. This pattern of the cistern animals having a lower life expectancy rate continues: the chances of an animal reaching the age of 2.5 years are 30% lower for the cistern sample (28% fused epiphysis) than for the reservoir sample (58% fused epiphysis). The rise observed in the survival curves (fig. 4.5, Groups A-B, D-E) is most likely due to the small samples available from Groups B and D.

Percentages of Meat-rich and Meat-poor Bones

The relative meat value of bones has been discussed by Lepiksaar (1969: 4) and Uerpmann (1973: 316). High meat value is found in bones of the vertebral column (excluding the tail), upper leg bones, and bones of the shoulder and pelvic girdle.

Table 4.4 Percentages of fused epiphyses among sheep/goats from Square B.1 and Cistern D.6:33. (F = fused; U = unfused).

	Group A			Group B			Group C			Group D			Group E		
	F	U	%	F	U	%	F	U	%	F	U	%	F	U	%
B.1	113	19	86%	25	5	83%	20	5	80%	7	5	58%	15	7	68
D.6:33	106	19	74%	13	3	81%	12	13	48%	4	10	28%	42	78	35%

Lower leg bones, tail, and bones of the feet have low meat value.

Table 4.5 shows recovery rates for meat-rich and meat-poor bones of sheep/goats. The mean recovery rate for meat-rich bones is higher for the cistern sample (54.46%) than for the reservoir sample (36.69%). The relative quantity of meat-rich and meat-poor bones of sheep/goats from the two samples is illustrated in fig. 4.6. The difference between the relative abundance of meat-rich and meat-poor bones is very large for both samples. In the meat-rich category from the cistern sample it can be seen that each skeletal element is better represented and that there is much less variance between the bone frequencies than for the reservoir sample. The proximal humerus is non-existent and the distal radius and the proximal femur are poorly represented in the meat-rich category from the reservoir sample whereas they are well represented in the cistern sample.

Figure 4.5 Survivorship curves of sheep/goats from Square B.1 and Cistern D.6:33.

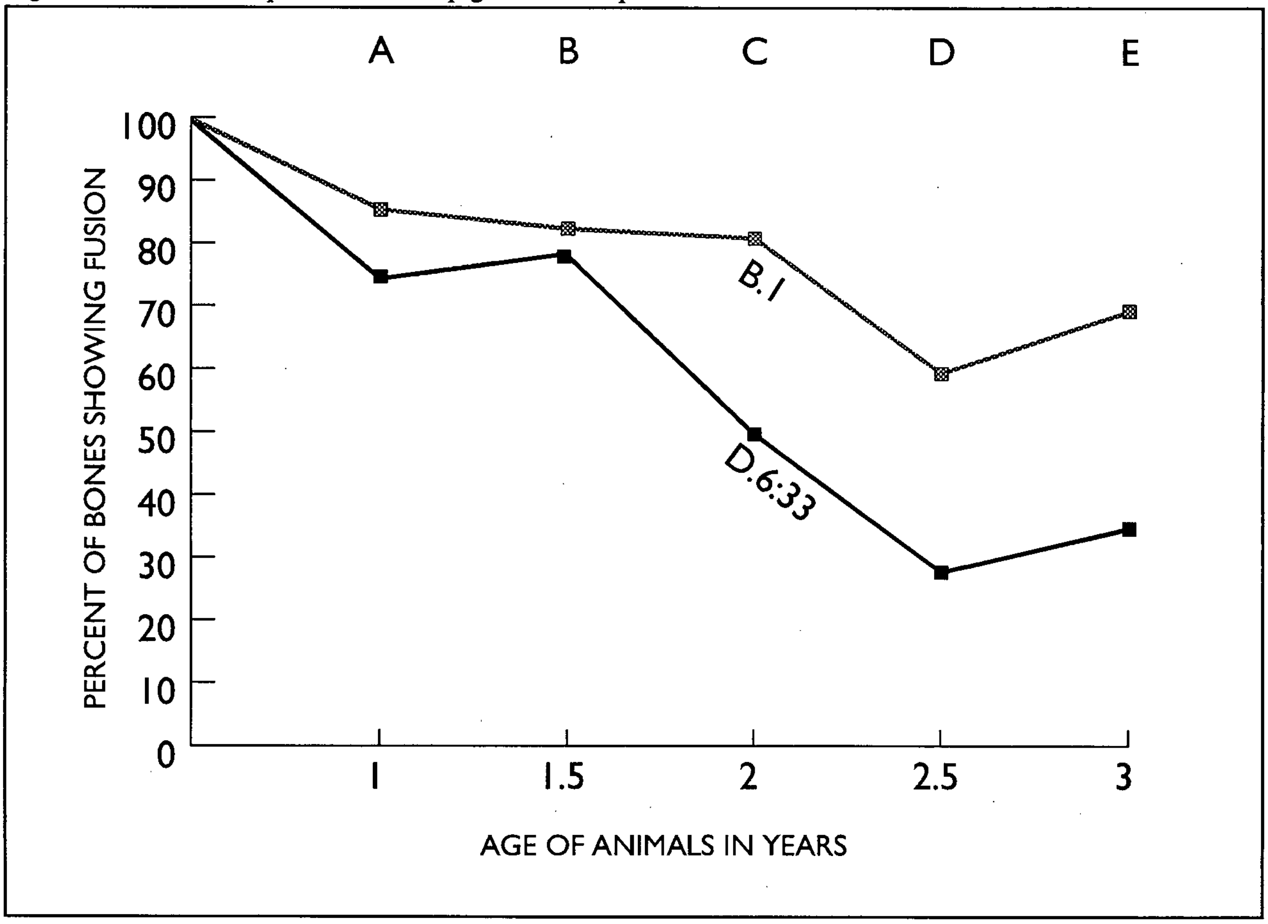


Table 4.5 Recovery rates for meat-rich and meat-poor skeletal elements of sheep/goats from Square B.1 and Cistern D.6:33.

Meat-Rich Bones	B.1	D.6.33	Meat-Poor Bones	B.1	D.6.33
atlas	17.24	12.00	prox. metacarpus	8.62	20.00
axis	41.38	20.00	dis. metacarpus	12.07	10.00
scapula	86.21	97.92	calcaneus	18.97	26.00
prox. humerus	0	14.00	talus	8.62	20.00
dis. humerus	84.48	72.00	prox. metatarsus	12.07	20.00
prox. radius	34.48	52.00	dis. metatarsus	8.67	10.00
dis. radius	10.34	62.00	phalanx 1	11.64	6.00
ulna	17.24	60.00	phalanx 2	0.86	2.50
pelvis	86.21	100.00			
prox. femur	1.72	54.00			
dis. femur	12.07	54.00			
prox. tibia	13.79	62.00			
dis. tibia	43.00	48.00			
Totals	448.26	707.92	Totals	81.47	114.50
mean recovery rate	36.69	54.46	mean recovery rate	10.18	13.87

Percentages of Butchering Marks

The percentage of skeletal elements showing butchering marks, such as knife cuts or possibly axe blows, is about the same for both samples: 22.58% (70) for the reservoir context and 23.53% (102) for cistern context. Figure 4.7 shows the raw counts of frequencies of butchering marks relative to raw counts of frequencies of skeletal elements of sheep/goats and illustrates this difference with a histogram.

Vertebrae. All categories of vertebrae are consistently low in number for both samples and only from the reservoir sample is there evidence of a butchering mark on a male atlas.

Forelimb. In both samples, butchering marks appear on the left scapula more frequently than on the right. Whereas no proximal humeri from the reservoir sample were recovered, from the cistern sample 6 left proximal humeri were found, all with butchering marks on them. Distal humeri are well represented and show high frequencies of butchering marks. There is a difference of 15 right humeri *versus* 8 left showing butchering marks in the cistern sample. From the reservoir sample, except for the high incidence of butchering marks on right and left proximal radius, there are only a few butchering marks on the rest of the bones of the forelimb. In contrast to this, with the exception of the right ulna, the radii and ulna from the cistern sample show varying frequencies of butchering marks and a strikingly high frequency (12) for the left ulna.

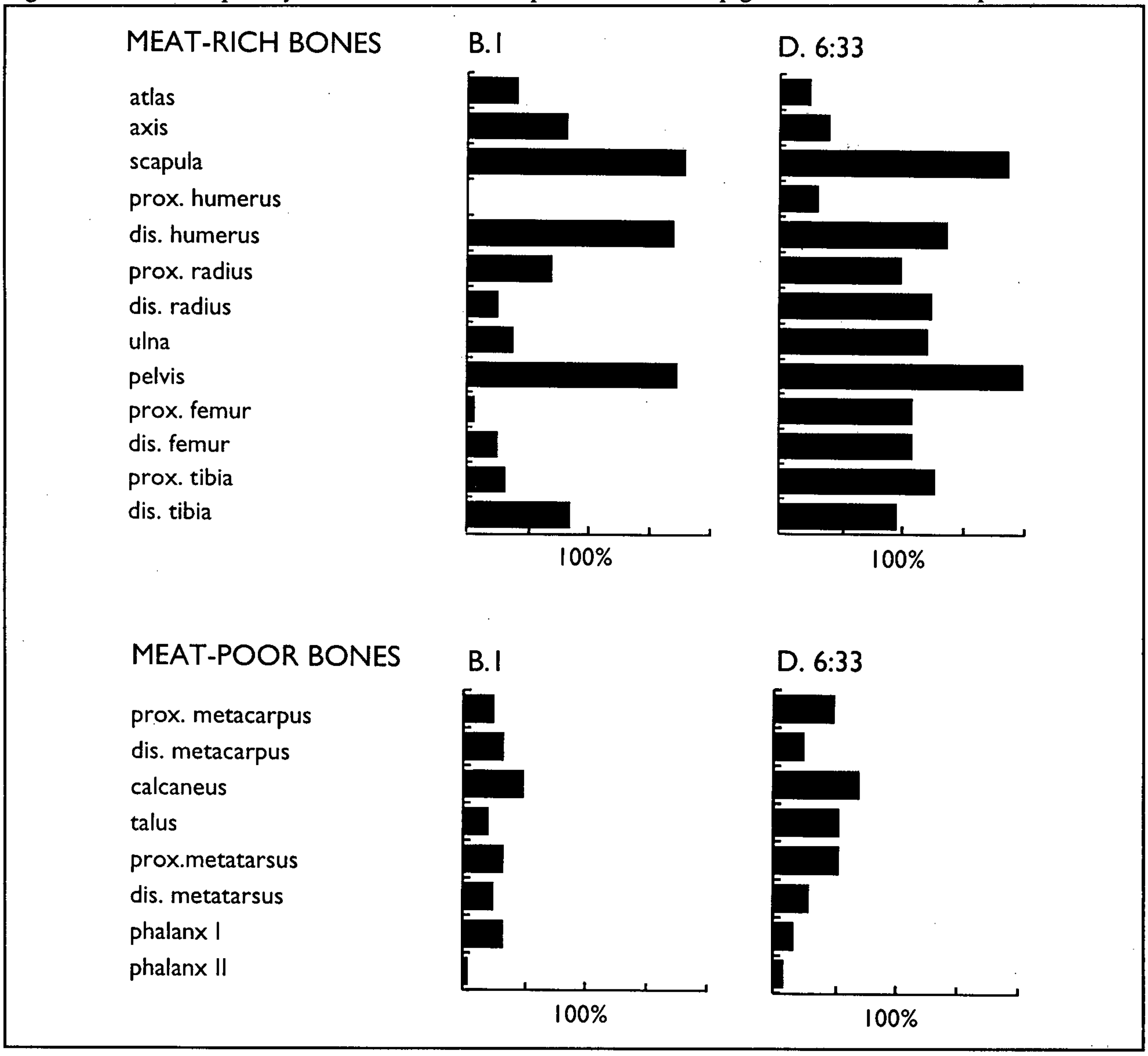
Pelvis and hind limb. There is a significant difference between the two samples when the frequencies of butchering marks on the pelvis and hind limb are compared. Whereas in the reservoir sample only 8.40% (10) of the bones of the hind limbs appear to have been butchered, twice that figure, 16.50% (35) show evidence of butchering marks in the cistern sample. Bones showing the most butchering marks are first, in the reservoir sample, only the left female pelvis; second, in the cistern sample, the left pelvis, the right female pelvis, right and left proximal femur and the right distal femur, and finally the right proximal tibia. No significant frequency can be observed in the first and second phalanx from either sample.

Cultural Patterning

From the foregoing data it is apparent that cultural patterning does seem to "shine through" despite differences between the two samples when it comes to post-depositional preservation. Differences were particularly noticeable in regard to ratios of sheep to goats, ratios of males to females, ratios of young to old animals, and in the percentages of meat-rich and meat-poor bones.

Our case for arguing that these data actually reflect different cultural practices can be strengthened further by examining them in the light

Figure 4.6 Relative quantity of meat-rich and meat-poor bones of sheep/goats from the two samples.



of an explicit interpretive framework. A place to begin is Paine's (1972: 76-87) research on the dynamics of herd management, by which he means "the activities a herd owner carries out with regard to his own family herd and others and their herds." According to his schema, herding and husbandry are defined as different aspects of herd management.

> Herding is concerned with the herd/pasture relationship as directed to the welfare of the animals, and ideally, to the exclusion of the comfort of the herders themselves. Husbandry, on the other hand, is concerned with the herd as the harvestable resource of its owners. While the tasks of herding, then, are those of the control and nurturance of animals in the terrain; husbandry may be conceptualized as the efforts of the owners in connection with the growth of capital and the formation of profit. The problems of herding are those of economy and labor and they may usually be solved by owners in conjunction with each other; those of husbandry concern the allocation of capital and here each family herd is usually wholly responsible unto itself. (Paine 1972: 79)

Slaughter involves the "selective allocation of animals to the realization of cultural values, in particular the provision of outer clothing where premium is placed upon color and other qualities of the skins" (Paine 1972: 79). When to slaughter an animal is, therefore, a decision of husbandry. Likewise, "allocation of animals to realization of

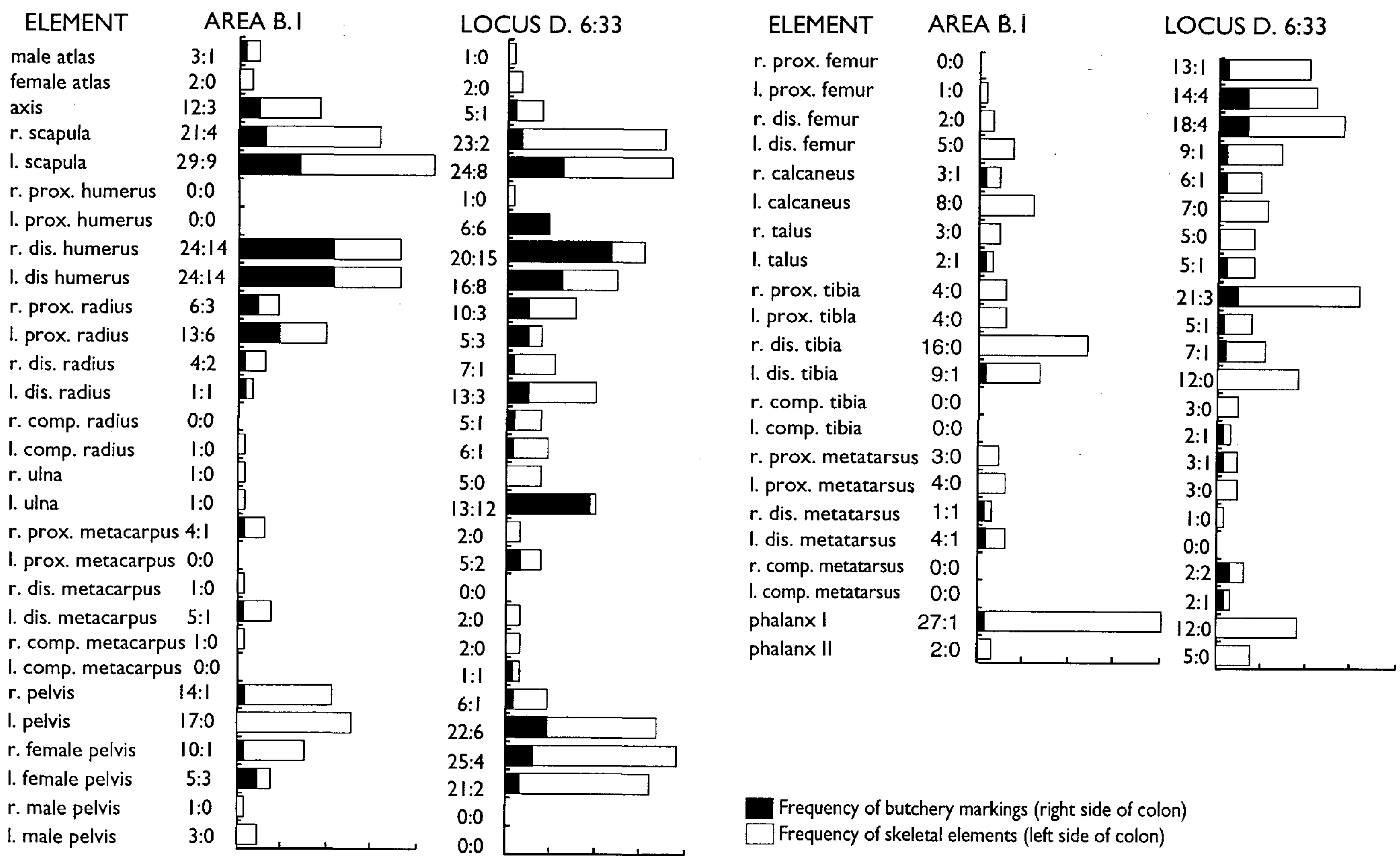


Figure 4.7 Relative differences between frequencies of butchering marks and frequencies of skeletal elements of sheep/goats from Square B.1 and Cistern D.6:33.

liquid capital, *i.e.*, money: retention of maximum number of females as breeding animals and also of a select number of stud bulls" is also a decision of husbandry (Paine 1972: 79). Paine further qualifies the notion of herd management by distinguishing between intensive and extensive herding and husbandry.

> *Intensive herding* indicates strict control of the herd. It follows that the greater the extent to which herders control the movements of the herd, the more the responsibility for the attainment of optimal conditions for its welfare lies with them. *Extensive herding* indicates that the animals for long periods of the year are not herded, or herded very little. The characteristic operation here is the periodic large-scale round-up of animals.... The procedure whereby an owner may himself slaughter a few animals periodically throughout the year is identified with intensive husbandry. Alternately, when an owner chooses to sell relatively large numbers of animals twice or three times a year, and sell them alive, which means the forfeiture of the right to any of the meat and all of the other natural products; this procedure is exclusive to extensive husbandry." (Paine 1972: 80-82)

Paine's schema offers a place to begin in accounting for the differences between the bone samples from the two micro-contexts. To begin with it will be recalled that whereas the reservoir sample was produced by a late Iron Age (sixth-seventh century B.C.) cultural context, the cistern sample stems from an Ayyubid-Mamluk (12th-14th centuries A.D.) context. What we shall attempt to show next is that the differences noted earlier with regard to the two bone samples are indicative of differences between the two historical contexts when it comes to the goals of herd management.

For example, during the Iron Age, greater emphasis appears to have been placed on intensive husbandry. This can be inferred from several of the indicators discussed above. To begin with there are the age ratios, which during the Iron Age favor older animals. Herds of sheep and goats were produced, it seems, not for the sake of sale as live young animals to distant markets, but for the sake of the wool and milk that they could produce as mature animals.

The sex ratios for the Iron Age herd are consistent with this conclusion. Compared with the Ayyubid-Mamluk sample, the ratio of males to females is much lower (13 females to 5 males from the Iron Age sample compared with 32 females to only 1 male from the Ayyubid-Mamluk sample). Thus, it appears that during the Iron Age more males appear to have been kept by their owners. When these were slaughtered, it was mostly for domestic consumption.

In contrast to the emphasis on intensive husbandry which appears to have prevailed during the Iron Age, the Ayyubid-Mamluk herders of the Hesban region appear to have pursued more extensive strategies. Their emphasis seems to have been more on producing animals for meat. The evidence for this begins with the age and sex ratios again. As has already been noted, the Ayyubid-Mamluk sample produced a much greater quantity of young animals, and many more males. Very likely, many of these young animals were not produced by the local inhabitants of the tell; instead, they were imported from herds belonging to more distant herdsmen engaged in extensive husbandry.

Support for this inference is provided by the data on percentages of meat-rich and butchered bone fragments. As would be expected, meat-rich skeletal parts were more abundant in the Ayyubid-Mamluk sample than in the Iron Age sample. Furthermore, the bones from the later period also had more butchering marks on them.

It remains to account for the difference between the two periods when it comes to ratios of sheep and goats. Two explanations are possible. On the one hand, the fact that goats were more numerous in the Ayyubid-Mamluk sample might be attributed to worsening pasturage conditions due to general deterioration of the landscape over the centuries since the Iron Age (*cf.* Boessneck and von den Driesch, chapter 5 in this volume).

On the other hand, the difference between the two samples in the sheep/goat ratio might be explained in light of the differences noted earlier with regard to herd management strategies. Given an emphasis on extensive husbandry and meat production during the Ayyubid-Mamluk period, goats have certain advantages over sheep. These include the fact that they can easier be produced under extensive herding conditions and the fact that they can be raised easier than sheep on marginal lands on the periphery of cultivated areas.

What we have here, then, is plausible evidence of cultural patterning in the two bone samples. Whereas the bones from the Iron Age reservoir micro-context point to a society engaged primarily in subsistence production of sheep and goats, the finds from the Ayyubid-Mamluk cistern context point to a society dependent on trade and markets for its meat supply. As we have discussed elsewhere (LaBianca 1990), this conclusion is consistent with a range of other lines of archaeological data from these two periods.

Conclusions

As we have seen, investigations of micro-contexts can yield important insights into the way in which different depositional environments impact the preservation of animal bones. They can also yield information about cultural patterning. We have offered in the present chapter examples of both. It remains to consider the pros and cons of micro-contextual investigations.

As was noted at the outset of this chapter, a major advantage of the micro-contextual approach is that it is more readily adaptable to situations where uncertainty prevails with regard to the chronological and stratigraphical context of bone finds. This, it will be recalled, was the reason the approach was adopted in the present instance.

A second advantage of this approach is that it focuses attention on the interaction of post-depositional processes with pre-depositional cultural processes. In other words, it allows for greater control of the different factors which, in various ways, contribute to the formation of the zooarchaeological record at any particular place and point in time.

A third advantage of the micro-contextual approach is that it can serve as a catalyst for closer cooperation between excavators and faunal analysts. Not only does the approach depend on careful feedback on archaeological context information from excavators, it allows comparatively prompt feedback of zooarchaeological observations and interpretations to the excavators.

Despite these advantages of the micro-contextual approach, there are some disadvantages as well. The most obvious one is that it requires splintering of bone assemblages into smaller, analytically distinguishable "samples." Attention is then focused on these samples, while the bulk of the bone assemblage is left unexamined. Furthermore, this approach tends to result in rather small sub-divisions of the data, a situation which makes statistical treatment of it untenable or of limited value.

As already mentioned, the approach did serve a useful purpose on the Heshbon Expedition in that it allowed preliminary reports to be produced which, in turn, helped generate support for continuation of the bone work from season to season. As the chapters which follow demonstrate, however, extremely valuable information can also be gained from studies of entire assemblages, especially if some sort of temporal frame can be imposed on the data.

This is especially important when it comes to investigations of the relative importance of different species from one period to the next, and when it comes to osteometric studies of changes over time in the physical stature of animals. Were it not that it was possible to lump together bones from multiple micro-contexts, yes even whole strata, such analysis would not have been feasible in the case of the assemblage from Tell Hesban.

An important lesson has thus been learned for the future. It is that as zooarchaeologists go to work on bone assemblages from large, multi-period sites such as Tell Hesban, the best result will no doubt come from strategies which combine both micro-contextual and macro-contextual approaches. Such a combined strategy will enable conclusions yielded by both approaches to be checked against each other, thus adding rigor to the whole enterprise of zooarchaeological analysis. Most important of all, it will expand the types of information which can be distilled from such bone assemblages, whether it be information about the history of the animals themselves, the history of the natural habitat in which they lived, or the history of utilization by humans.

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Chapter Five

FINAL REPORT ON THE ZOOARCHAEOLOGICAL INVESTIGATION OF ANIMAL BONE FINDS FROM TELL HESBAN, JORDAN

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Chapter Five

Final Report on the Zooarchaeological Investigation of Animal Bone Finds From Tell Hesban, Jordan[1]

Introduction

It is no longer possible to ascertain the precise number of animal remains gathered during the five archaeological excavations, each lasting several months, which were carried out on Tell Hesban near Madaba, Jordan, between 1968 and 1976. The reasons behind this are explained in our preliminary report. Only the finds from the 1976 excavation could be recorded in detail and are, thus, suitable for use in quantitative statistical comparisons. While those bone finds from the 1968 to 1974 excavations which are still in existence were included in our investigations, their contribution was restricted to zoological, zoogeographical, and metrical data.

The individual procedures which were used in the recording of the 1976 bone finds and of the remaining bones from the earlier excavations are described in the preliminary report, together with the methods used to evaluate the data obtained in each individual case. There is, therefore, no need to discuss questions of methodology here.

An estimated total find of approximately 100,000 bones would have been accumulated for classification by species had all of the finds been counted from the very beginning. Of these, around 20,000 are from the 1976 excavation. The task of the zooarchaeological analysis of this large collection was shared among several people: preliminary reports (LaBianca 1973; Boessneck and von den Driesch 1978, 1981); documentation (Weiler 1981 "mammals"; Lindner 1979 "domestic fowl"; Boessneck, chapter 8 "birds, reptiles, and amphibians"; Lepiksaar, chapter 9 "fish"; Crawford 1976 "molluscs"); special reports: (Boessneck 1977 "weasel finds"; Boessneck and von den Driesch 1977 "deer finds"; LaBianca 1975, 1977, 1978, 1979; LaBianca and LaBianca 1975a, 1976). This report summarizes the most important results of those investigations.

The Finds: A Synopsis

The great majority of the animal bone finds represents part of the day-to-day refuse of human society and originates from the settlement of the hill during prehistoric and early historical times. Most of the remains are those of animals slaughtered in the settlement, of animals killed and/or collected in the surrounding area, or of animals brought to the settlement in the course of trade. A small part represents a different kind of refuse found in any settlement; for example, the perfunctorily buried carcasses of dogs and cats. It is the actual domestic refuse, consisting largely of the bones of domestic animals, but also of those of game animals and of fish, which provides the most important information from a historico-cultural point of view; namely, which species of animals were kept by the former inhabitants of the settlement and in what relative numbers; how these animals were utilized and what products were obtained from them; and what additional animals were hunted and collected. However, it is only in exceptional cases, and then only where wild fauna are concerned, that we can offer an opinion as to whether animals were also purchased or imported. Last, but not least, animal bone finds help to reconstruct the former character of the landscape.

Some of the bones found (the precise number cannot be determined) are the result of natural thanatocoenosis. They are the remains of animals whose presence at Tell Hesban owed nothing to direct action on the part of Man. They may have been living as commensals in the houses during the

Figure 5.1 Mole rat, *Spalax ehrenbergi* (after Tristram 1884: pl. 5).

time the hill was in use or they may have inhabited the hill after its abandonment. In short, the remains of these animals may originate from a much later period than that indicated by the dating of the objects with which their bones were found. As we have explained elsewhere (Boessneck and von den Driesch 1978: 262f., 1981: 56), this group principally comprises the bones of burrowing animals and of those which use their tunnels: weasels, small mammals, reptiles, and variegated toads. It is also possible that the remains of rabbits belong to this group. One of the prime indicators of possible discrepancies in the dating is the presence of bones of the mole rat, *Spalax leucodon ehrenbergi* (fig. 5.1), a nocturnal rodent, which lives underground and digs an extensive system of tunnels, often several meters deep and penetrating different archaeological strata. In these tunnels it is possible for archaeological items several centimeters in diameter to be moved by the activities of the animals themselves from their original resting places, without the archaeologist being able to recognize that this has happened. The species identified from the bone finds of Tell Hesban are listed in tables 5.1 to 5.5.

The species can be grouped as follows: domestic mammals, at least 10 species; domestic poultry, 3 species; wild mammals (including 6 species of small rodent), at least 32 species; wild birds, at least 42 species; reptiles, 4 species; amphibians, 1 species; and fish, at least 16 species.

The bone finds give us a complete record of the domestic animals kept, or occurring, on Tell Hesban and in the surrounding area. The record of wild mammals occurring is almost complete.

Table 5.1 Species of domestic animals identified among the Tell Hesban finds.

Common name	Scientific name
cattle	*Bos primigenius f. taurus*
sheep	*Avis orientalis f. aries*
goat	*Capra algagrus f. hircus*
pig	*Sus scrofa f. domestica*
horse	*Equus ferus f. caballus*
ass	*Equus africanus f. asinus*
mule/hinny	-
camel	*Camelus dromedarius f. domestica*
dog	*Canis lupus f. familiaris*
cat	*Felis silvestris f. catus*
rabbit	*Oryctolagus cuniculus f. domestica*
domestic chicken	*Gallus gallus f. domestica*
domestic goose	*Anser anser f. domestica*
domestic pigeon	*Columba livia f. domestica*

Table 5.2 Wild mammal species identified in the finds from Tell Hesban.

Species	Number of bones
Persian fallow deer, "Dama mesopotamica"	51
maral, *Cervus elaphus maral*	4
?aurochs, *Bos primigenius*	8
mountain gazelle, *Gazella gazella*, and dorcas gazelle, *Gazella dorcas*, and/or Persian gazelle, *Gazella subguttorosa*	331
Arabian oryx, *Oryx leucoryx*	1
Nubian ibex, *Capra ibex nubiana*	14
wild goat, *Capra aegagrus*	5
wild sheep, *Ovis orientalis*	8
wild boar, *Sus scrofa lybicus*	139
?Syrian onager, *Equus onager hemippus*	6
rock hyrax, *Procavia capensis syriacus*	1
grey wolf, *Canis lupus*	1
red fox, *Vulpes vulpes palaestina*	84
?sand fox, *Vulpes rueppelli*	6
badger, *Meles meles canescens*	8
ratel, *Mellivora capensis*	1
weasel, *Mustela nivalis*	32
marbled polecat, *Vormela peregusna syriaca*	10
Syrian beach marten, *Martes foina syriaca*	3
mongoose, *Herpestes ichneumon*	1
hyena, *Hyaena hyaena syriaca*	7
wildcat, *Felis silvestris tristrami*	2
lion, *Panthera leo*	2
leopard, *Panthera pardus*	2
cape hare, *Lepus capensis*	30
house rat, *Rattus rattus*	32
house mouse, *Mus musculus*	2
Tristram's jird, *Meriones tristrami*	42
mole rat, *Spalax leucodon ehrenbergi*	158 + 2 skel
porcupine, *Hystrix indica*	1
broadtoothed fieldmouse, *Apodemus mystacinus*	2
Persian vole, *Microtus irani*	7
Total	< 1000

Table 5.3 Species of wild birds identified among the Tell Hesban finds.

	Number of Bones	MNI*
ostrich, *Struthio camelus syriacus*	4	3
white stork, *Ciconia ciconia*	3	3
flamingo, *Phoenicopterus ruber roseus*	1	1
Egyptian vulture, *Neophron percnopterus*	9	6
griffon vulture, *Gyps fulvus*	7	2-3
black vulture, *Aegypius monachus*	2	1
eagle species	1	1
European sparrowhawk, *Accipiter nisus*, or Levant sparrowhawk, *Accipiter brevipes*	1	1
black kite, *Milvus migrans migrans*	1	1
peregrine falcon, *Falco peregrinus*, or desert falcon, *Falco pelegrinoides*, or Lanner falcon, *Falco biarmicus*	1	1
kestrel, *Falco tinnunculus*	3	2
lesser kestrel, *Falco naumanni*	1	1
chukar partridge, *Alectoris chukar*	229	56
Arabian sand partridge, *Ammoperdix heyi*	1	1
quail, *Coturnix coturnix* (partial skeleton)	(9)	
crane, *Grus grus*	1	1
corncrake, *Crex crex*	20	9
coot, *Fulica atra*	3	3
great bustard, *Otis tarda*	4	3
Houbara bustard, *Chlamydotis undulata*	14	6
cream-colored courser, *Cursorius cursor*	2	2
stone curlew, *Burhinus oedicnemus*	2	1
black-bellied sandgrouse, *Pterocles orientalis*	2	2
dom. pigeon, *Columba livia domestica*, and rock dove, *Columba livia*	137	31
palm dove, *Streptopelia senegalensis*	3	3
barn owl, *Tyto alba*	1	1
little owl, *Athene noctua lilith*	21	4
short-toed lark, *Calandrella brachydactyla*, or lesser short-toed lark, *Calandrella rufescens*	1	1
crested lark, *Galerida cristata*, or skylark, *Alauda arvensis*	4	3
woodlark, *Lullala arborea*	1	1
warbler, *Hippolais* species	1	1
Isabelline wheatear, *Oenanthe isabellina*	2	2
wheatear, *Oenanthe* species	2	2
blackbird, *Turdus merula*	1	1
corn bunting, *Emberiza calandra*	2	2
bunting, *Emberiza* species	3	2
house sparrow, *Passer domesticus*	6	4
rock sparrow, *Petronia petronia*	5	1
common starling, *Sturnus vulgaris*, or rose-colored starling, *Sturnus (Pastor) roseus*	30	10
jackdaw, *Corvus monedula soemmeringii*	3	3
brown-necked raven, *Corvus ruficollis*	3	3
common raven, *Corvus corax subcorax*	10	4

* MNI = Minimum Number of Individuals

Quantitative changes in the occurrence of domestic animals over periods of time are a reflection of ecological, political, and population change. The spectrum of reptiles and amphibians presented by the finds would seem to be more or less a matter of chance, and there are large gaps. The same is true, to an even greater extent, of the wild birds. While it is likely that we have a complete record of all species of sea fish which were brought in, this is not the case as far as freshwater fish are concerned.

Table 5.4 Species of reptiles and amphibians identified among the Tell Hesban finds (total bone finds from all excavations).

Species	Number of Bones
tortoise, *Testudo graeca terrestris*	91 + 3 skeletons
hardoun, *Agama stellio*	13
Scheltopusik, *Ophisaurus apodus*	1 skeleton
racer, *Coluber* species	23 + 1 skeleton
variegated toad, *Bufo viridis*	71 skeletons

Table 5.5 Species of fish identified among the Tell Hesban finds.

Species
Family Cyprinidae, Carps
Barbus species
?*Varicorhinus damascinus*
Family Clariidae, Eel-shaped catfish
Clarias lazera
Family Mugilidae, Grey Mullets
?*Mugil* (*Crenimugil*) *labrosus*
?*Mugil* (*Liza*) *ramada*
Family Serranidae, Basses
Polyprion americanus
?*Epinephelus* species
Family Sciaenidae, Drums and Croakers
Johnius hololepidotus
Family Sparidae, Sea Breams
Sparus (*Chrysophrys*) ?*auratus*
Family Cichlidae, Cichlids
Tilapia galilaea, and/or *Tilapia nilotica*
?*Tristramella sarca*, or *Tristramella sinonis*
Family Scaridae, Parrotfishes
Sparisoma species
Pseudoscarus species
Family Scombridae, Mackerels and Tunnies
Auxis thazard
Katsuwonus pelamis
Euthynnus affinis

Table 5.6 Cultural divisions at Tell Hesban.

Stratum	Designation	Type of Settlement	Dates	Culture
1	AM01	From cave dwellers to major village	A.D. 1870-1976	Modern
-	-	— 414-year gap, no sedentary occupation attested —	-	-
2	AM02	Gradual abandonment of Early Mamluk town	A.D. 1400-1456	Late Mamluk
3	AM03	Large scale reconstruction using Roman-Byzantine ruins	A.D. 1260-1400	Early Mamluk
4	AM04	Small village in beginning stages	A.D. 1200-1260	Ayyubid
-	-	— 239-year gap, no sedentary occupation attested —	-	-
5	BA01	No architectural remains, artifacts only	A.D. 750-969	Abbasid
6	BA02	Town continues to grow, sudden decline	A.D. 661-750	Umayyad
7	BA03	Major town with temples, churches, acropolis	A.D. 614-661	Late Byzantine
8	BA04	Major town with temples, churches, acropolis	A.D. 551-614	Late Byzantine
9	BA05	Major town with temples, churches, acropolis	A.D. 408-551	Early/Late Byzantine
10	BA06	Major town with temples, churches, acropolis	A.D. 365-408	Early Byzantine
11	HR01	Village becoming temple town	A.D. 284-365	Late Roman-Early Byzantine
12	HR02	Earthquake	A.D. 193-284	Late Roman
13	HR03	Rapidly growing village	A.D. 130-193	Late Roman
14	HR04	Small village, many cave dwellers	63 B.C.-A.D. 130	Early Roman
15	HR05	Small fortified settlement, some caves used	198-63 B.C.	Late Hellenistic
-	-	— 314-year gap, no sedentary occupation attested —	-	-
16	IR01	Village developing into town	700-500 B.C.	Iron 2
17	IR02	Destroyed	900-700 B.C.	Iron 2
18	IR03	Small village, destroyed and rebuilt	1150-900 B.C.	Iron 2
19/20	IR04/5	Small village, destroyed and rebuilt	1200-1150 B.C.	Iron 1

Notes on Dating of Finds and Temporal Distribution

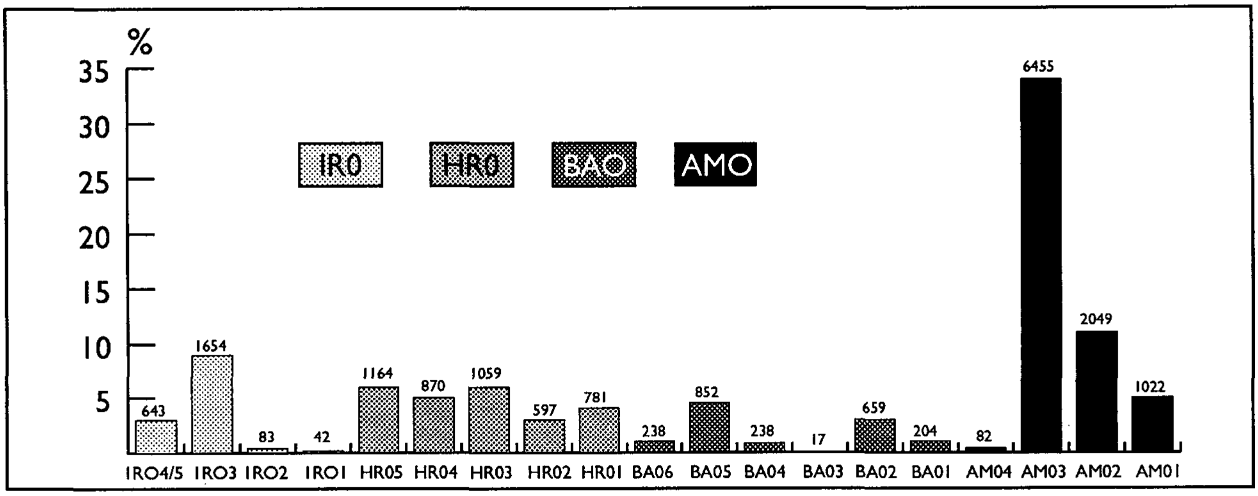
The finds span *ca.* 1200 B.C. to A.D. 1450. Successive cultural divisions have been determined on the basis of archaeological findings and historical criteria (table 5.6).

The finds from the 1976 excavation are distributed very unevenly over the periods listed above. This distribution, as it appears in fig. 5.2, takes account only of the bones of domestic animals and those of the most important wild mammals. It is, however, representative of the finds as a whole. The distribution reflects in part the density of the settlements during the individual settlement phases, and is also influenced by the length of time for which each phase lasted. By far the smallest number of finds originates in the Iron Age (Strata 16-19) and Byzantine (Abbassid) period (Strata 5-10). More than a quarter of all finds stem from the Hellenistic-Roman phases of settlement (Strata 11-15) and almost half of the material found is dated as belonging to the Mamluk period (Strata 2-4).

This pattern of distribution of the animal bones coincides, with one exception, with the archaeological and historical results of the excavation. It also corresponds, with the same exception, with observations of the settlement density within a radius of 10 km of Tell Hesban based on surveys carried out by Ibach (1981, 1987) and LaBianca (1990). According to these, the area around Tell Hesban has been continuously settled in differing degrees from the Late Bronze Age (around 1550 B.C.) until modern times. This occupational pattern is of considerable importance for the evaluation which follows of the results obtained from the animal bone finds of Tell Hesban.

The exception mentioned above concerns the Byzantine period. It was apparently during this period that Tell Hesban attained its greatest importance, characterized by the archaeologists carrying out the excavation as a "major town with temples, churches and acropolis" (Storfjell 1979; see also Geraty 1977). Judging from the results of the surveys, the settlement density in the area immediately surrounding Tell Hesban was at its greatest (table 5.7). This expansion contrasts with a relatively small quantity of animal-bone finds (fig. 5.2, table 5.8). Only one conclusion can be drawn from this. In a central area consisting principally of religious buildings, the acropolis, there were only a few people living who would produce refuse. The archaeological investigation did not encompass the actual residential area of the "major town."

Figure 5.2 Distribution of the total number of bone-finds according to phases.



Archaeoeconomic and Zoological Research Section

Domestic Animals

The long list of wild mammals and birds (tables 5.2 and 5.3) should not be allowed to disguise how unimportant, from an economic point of view, game was for the inhabitants of Tell Hesban. The bones of wild mammals amount to between only 1% and 2% of finds, depending on the period in question (table 5.8), and those of wild birds to even less. Animal husbandry, along with agriculture, were the main sources of food and animal products.

Table 5.7 Regional sites within 10 km of Tell Hesban (Ibach 1981).

Date	Culture	Number of Sites
ca. 1550-1200 B.C.	Late Bronze	5 sites
ca. 1200-918 B.C.	Iron 1	28 sites
ca. 918-332 B.C.	Iron 2-Persian	59 sites
ca. 332-63 B.C.	Hellenistic	17 sites
ca. 63 B.C.-A.D. 193	Early Roman	54 sites
ca. A.D. 193-365	Late Roman	45 sites
ca. A.D. 365-661	Byzantine	125 sites
ca. A.D. 661-750	Umayyad	32 sites
ca. A.D. 750-1200	Abbassid-Crusader	0 sites
ca. A.D. 1200-1456	Ayyubid-Mamluk	49 sites
ca. A.D. 1456-1870	Late Mamluk-Ottoman	0 sites

The list of domestic animals (tables 5.9 and 5.10) includes sheep and goats, cattle, pigs, horses, asses (and their hybrids, mules, and hinnies, whose presence is difficult to prove from the osteological point of view), camels, dogs, cats, the rabbit, which was introduced from Europe, and the domestic chicken, the only species of domestic poultry mentioned in table 5.10.

Sheep and goats were from the outset the most abundant of the domestic animals. The number of sheep and goat bones increase in Hellenistic-Roman times, decrease in relative terms during Byzantine times and increase again to a greater extent in the final stages of settlement.

The age distribution of the small ruminants was investigated on the basis of the lower jaws. Teeth cannot be used to distinguish between sheep and goats. The study of tooth eruption and wear does,

Table 5.8 Ratio of domestic to wild mammals (1976 campaign).

	Iron		Hellen-Roman		Byzan-tine		Ayyubid-Mamluk	
	n.	%	n.	%	n.	%	n.	%
Domestic	2495	98.8	4482	98.2	2195	98.4	8577	97.9
Wild	30	1.2	82	1.8	35	1.6	186	2.1
Totals	2525	100.0	4564	100.0	2230	100.0	8763	100.0

("Wild" mammals comparison excludes small rodent finds.)

Table 5.9 Number of finds of domestic mammals (1976).

Stratum	Cattle	Small Ruminants Total	Sheep	Goat	Pig	Camel	Equids Total	Horse	Ass	Dog	Cat	Total
1	60	908	36	52	25	9	54	5	19	41	8	1105
2-3	1117	6901	353	402	139	215	27	6	14	51	13	8493
4	9	71	4	6	-	2	2	-	-	-	-	84
5	8	188	14	11	2	5	2	-	-	-	-	205
6	68	494	47	33	80	8	6	-	3	4	2	662
7-10	162	932	58	48	130	14	63	5	10	26	1	1328
11-13	286	1892	140	115	183	17	58	2	6	16	3	2455
14	131	682	67	36	43	7	10	-	3	4	-	877
15	136	977	135	75	6	15	4	-	1	12	-	1150
16-18	256	1406	137	83	94	5	29	-	9	53	-	1843
19	145	460	38	29	31	3	13	-	6	-	-	652
Total	2378	14911	1029	890	733	300	298	18	71	207	27	18854

however, provide a more accurate means of determining age than the state of epiphysial fusion in the bones of the extremities, most of which are so fragmentary that they cannot be evaluated.

It can be seen from table 5.11 that in the Hellenistic/Roman period, more sheep and goats were slaughtered as juveniles than as adults, while in both the Byzantine and Mamluk phases the rate of slaughter is roughly the same for animals under and over two years old. The lower jaws from the Iron Age are predominantly those of older sheep and goats.

From the Iron Age until the Byzantine period, sheep were more plentiful than goats (fig. 5.3). On the other hand, during the Ayyubid/Mamluk period there was a noticeable increase in the number of goats. These findings suggest that the pasturage must have changed from grass to weeds, and, thus, deteriorated over time. This interpretation is supported by the fact that cattle also appear to have been more plentiful during the earlier period, as well as the fact that the size of cattle in the Arabian settlement phase was smaller than it was in Roman and Byzantine times. Cattle were exploited to the fullest for as long as they lived; they were, after all, the most valuable domestic animals. There is scarcely any evidence of the slaughtering of calves.

Among the cattle-bone remains were three thoracic vertebrae with sagitally-split spinal processes which could be considered characteristic of humped cattle or zebus. Humped cattle must, therefore, have comprised at least a part of the cattle population during that period. This interpretation is supported by the fact that humped

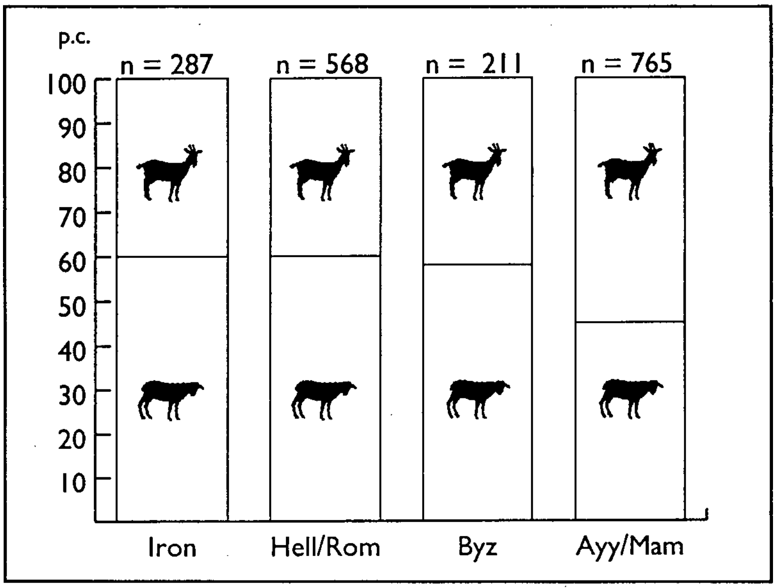
Table 5.10 Relative percentages of domestic animals (incl. chicken), 1976 campaign.

	Iron n.	Iron %	Hellen-Roman n.	Hellen-Roman %	Byzantine n.	Byzantine %	Ayyubid-Mamluk n.	Ayyubid-Mamluk %
Sheep/Goat	1866	74.8	3351	76.1	1614	70.3	6972	75.1
Sheep	175	-	342	-	119	-	357	-
Goat	112	-	226	-	92	-	408	-
Cattle	401	16.1	553	11.8	238	10.4	1126	12.1
Swine	125	5.0	232	5.0	212	9.2	139	1.5
Horse/Ass	42	1.7	72	1.5	71	3.1	59	0.6
Horse	-	-	2	-	5	-	6	-
Donkey	15	-	10	-	13	-	14	-
Camel	8	0.3	39	0.8	27	1.2	217	2.3
Dog	53	2.1	32	0.7	30	1.3	51	0.5
Cat	-	-	3	0.1	3	0.1	13	0.1
Rabbit	-	-	-	-	5	0.2	-	-
Chicken	-	-	186	4.0	96	4.2	711	7.7
Total	2495	100.0	4668	100.0	2296	100.0	9288	100.0

Table 5.11 Slaughter age of sheep/goats relative to archaeological period.

State of Tooth	Approximate Age (years)	Iron	Hell-Rom	Byz	Ayy-Mam
M_1 -	under ¼	1	2	1	9
M_1 +/-	around ¼	3	4	-	9
M_1 +, M_2 -	¼ - ¾	2	8	2	12
M_2 +/-	around ¾	-	6	2	6
M_2 +, M_3 -	¾ - 1½	2	5	2	4
M_3 +/-	1½ - 2	1	2	1	6
M_3 +	over 2	5	4	5	20
M_3 ++	-	6	6	7	19
M_3 +++	-	1	6	2	7

Figure 5.3 Ratio of sheep and goats in the different settlement periods of Tell Hesban.



cattle are regularly portrayed on mosaics in the region of Madaba even as early as the Byzantine period. An example is the mosaic in the church on Mount Nebo, to which we have already referred (Boessneck and von den Driesch 1978: 263f., and pl. XXIV A).

Pigs form only a relatively small part of the livestock kept (table 5.10). However, it is noteworthy that the proportion of pigs to all other domestic animals grew from 5% in the Iron Age and Hellenistic-Roman times, to almost double that, namely 9.2%, in the Byzantine period. Pig-keeping apparently achieved its greatest economic importance during this period. By the late Middle Ages, the percentage of pig bones had dropped to 1.5%. In other words, the importance of pig-keeping declined as Islam made its way into the region.

The majority of pig bones are those of young animals. Occasionally, bones of piglets, stillbirths, and fetuses were found, and these indicate that pregnant sows were slaughtered and that piglets died at, or shortly after, birth.

In the finds from the Byzantine period, the number of equid bones is also relatively high. There is a numerical predominance of ass remains over horse remains, the ass being of far greater economic importance. Over and against this, the equids decline in significance during the Ayyubid/Mamluk phase of settlement (table 5.10). The task of carrying men and goods was now more often undertaken by dromedaries, animals for which the Arabic peoples have a particular affinity. As the percentages calculated reveal, the camel was less important in the period before the Arabic settlement of the tell.

Dogs were kept much more frequently than cats. In both cases there can be no doubt that their flesh was not eaten. In contrast to observations involving equid and camel bones, which often bear chip marks as a result of butchering (*e.g.*, Boessneck and von den Driesch 1978: pl. XXI and fig. 2), there are no such marks on dog and cat bones. Quite frequently, more or less complete skeletons of dogs and cats were to be found, clearly quickly and perfunctorily buried carcasses. Many of the bones belong to animals only a few weeks or months old. We list in tables 5.12 and 5.13 the locations at which skeletons and partial skeletons of dogs and cats were discovered, as this

Table 5.12 Location of dog skeletons.

Stratum	Locus	Description
18	C.1:128, 133	Whelp; partial skeleton
15	B.1:30	Young dog; almost complete
15	B.1:53	Whelp; partial skeleton
15	B.2:80	2 young dogs; almost complete
15	B.4:203	Whelp bones; few days old
15	B.4:205	Older juvenile dog bones
3	D.4:58	Whelp; partial skeleton
3	D.5:50	Whelp; partial skeleton
3	D.6:36	Young dog; partial skeleton
2	C.8:13	Whelp; partial skeleton
2	G.3:8	Whelp; partial skeleton

Table 5.13 Location of cat skeletons.

Stratum	Locus	Description
11	G.12:30	Adult cat; partial skeleton
3	A.7:45	Young cat; partial skeleton
3	C.5:3	Adult cat; partial skeleton
3	D.5:5	Adult cat; partial skeleton
3	D.6:33	Adult cat; partial skeleton
2	C.6:11	Adult cat; partial skeleton

information may be of general archaeological interest.

In describing the complete skeleton of a dog discovered in the first excavation, which is apparently supposed to have been buried without the head at B.1:24 (Stratum 15), Little (1969: 237) comments: "With the greatest reservation, the suggestion is made that possibly some cultic practice was involved in the killing and disposal of this animal." Serious doubts must be raised against such an interpretation of the find unless one is prepared to accept the existence of a dog cult for Stratum 15.

In the case of the five finds of the domestic rabbit, all of which are from the same location (F.30:3), and in all probability belong to the same individual (cranium, lower jaw, 1 tibia, 2 metatarsals), it is doubtful whether they are in fact of Byzantine origin, as indicated in the dating table. In close proximity were found the remains of Ehrenberg's mole rat. It may thus be assumed that the rabbit bones are the remains of a more modern animal brought down to these levels via the *Spalax* tunnels.

There is no reason why this should not have been so. After all, the Romans had kept rabbits and hares in special enclosures, the so-called "leporaria" (Zeuner 1967: 343f.). There would surely have been more finds of this highly fertile and adaptable animal, if indeed the rabbit had been kept as a domestic animal during the Byzantine period.

The bone assemblage of the 1976 excavation contained no cat or chicken bones from the earliest settlement phase (table 5.10). As far as the chicken is concerned, this must surely be a matter of chance, for the bone sample of the earlier excavations contained chicken bones belonging to the Iron II-Persian period (Stratum 16). Thus, the keeping of chickens was known to the inhabitants of the tell by the sixth or seventh century B.C. at the latest (Lindner 1979). The domestic chicken had originated in India, where it had been domesticated in the early third millennium. These few chicken bones, however, prove that the standard of chicken farming at this early stage was not high by any means. This situation first improved in Hellenistic-Roman times. A proportion of 4% of domestic animal finds in this period and 4.2% in the Byzantine era underline the importance of the chicken in the animal economy.

The importance of chicken farming clearly grew during the Ayyubid/Mamluk period (table 5.10). The chicken is an ideal domestic animal for arid regions such as those which surround Tell Hesban. Due to the poor overall feeding conditions, however, the animals remained small in size throughout (see below).

Finds of the domestic goose occupy a position of minor importance. Not more than fifteen, for the most part fragmentary, goose bones were found in the total finds of all excavations from 1968 to 1976 (Boessneck, chapter 8). Tell Hesban and its arid environs are poorly suited to the keeping of geese. It is, without doubt, better suited to the domestic pigeon, a fact which is reflected in the far greater quantity of pigeon bones found (Boessneck, chapter 8; table 8.7). However, in the present instance it is difficult to distinguish between the domestic pigeon and its wild progenitor, the rock dove. These two together form one population, and in human settlements where they live, all transitional stages from wild dove to domestic pigeon occur. Under the care and protection of humans, the pigeons increase in size. It is this fact which allows us to establish in principle that pigeons were kept at Tell Hesban. If however, all transitional stages, ranging in size from what is clearly a domestic pigeon down to something the size of the rock dove, are present in the finds, then a clear distinction becomes

Table 5.14 Bone weight in grams of the most important mammals (1976 campaign).

	Iron		Hellen-Roman		Byzantine		Ayyubid-Mamluk	
	n.	%	n.	%	n.	%	n.	%
Sheep/Goat	9235	43.7	13675	46.5	6920	42.8	28343	50.0
Cattle	7683	36.4	9446	32.1	4048	25.0	15732	27.8
Pig	638	3.0	1213	4.1	1745	10.8	963	1.7
Horse/Ass	2498	11.8	1958	6.7	2698	16.7	3643	6.4
Camel	784	3.7	2009	6.8	592	3.7	6688	11.8
Fallow Deer	49	0.2	442	1.5	-	-	26	-
Ibex/Wild Sheep	94	0.4	222	0.8	99	0.6	282	0.5
Gazelle	39	0.2	100	0.3	50	0.3	225	0.4
Wild Boar	119	0.6	330	1.1	24	0.1	773	1.4
Total	21139	100.0	29395	100.0	16175	100.0	56675	100.0

[1]Among them, the complete horn core of a male.

Figure 5.4 Ratio of the most important mammals, based upon the number of bones (a) and the weight of bones (b).

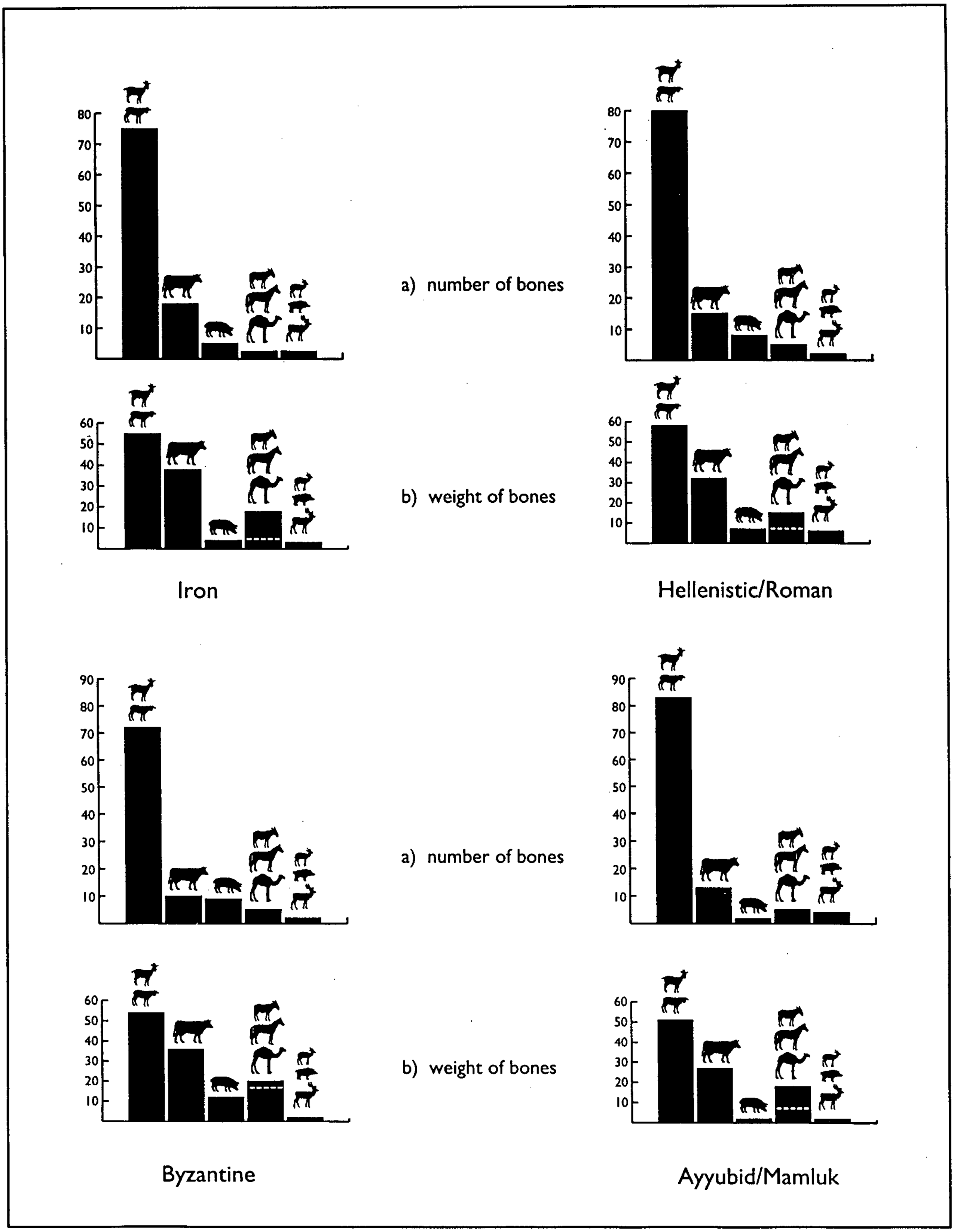


Table 5.15 Cattle: dimensions[1] of completely preserved metapodials and height of the animal at the withers (*cf.* von den Driesch and Boessneck 1974: 338).

a) Metacarpus

Locus	C.3:12[2]	C.2:40	D.4:138	8.2:128	C.4:1	B.2:128	C.5:3	?	B.1:47	D.6:33
Stratum	?	15	20	15	2	15	3	?	15	3
Sex	F	F	F	M?	M	M	F	F	F	F
GL	(238)	207	(199)	(195)	194.5	194.5	(193)	(192.5)	(192.5)	192
Bp	64	55	54.5	57	57	56.5	(52)	51	48	50.5
SD	34	29	26	31	32	31.5	28	27.5	25.5	30
Bd	-	55	-	57	(58)	57	55.5	(51)	-	52.5
SD × 100 / GL	14.3	14	13.1	15.9	16.5	16.2	14.5	14.3	13.2	15.6
WH in cm	142.8	124.2	119.4	122.9	122.5	122.5	115.8	115.5	115.5	115.2

b)[2] Metatarsus

Locus	B.2:133	C.3:6	C.3:5	B.7:10
Stratum	15	3	3	3
Sex	M	F	M	F
GL	237	(220)	216	191.5
Bp	47	-	44	35.5
SD	29	24.5	27.5	21.5
Bd	53.5	48	51.5	-
SD × 100 / GL	12.2	11.1	12.7	11.2
WH in cm	132.7	116.6	121	101.5

[1] Key to the abbreviations of measurements taken from von den Driesch 1976; where: M = male, F = female, GL = greatest length, Bp = greatest breadth of proximial end, SD = smallest breadth of diaphysis, Bd = greatest breadth of distal end, WH = height at the withers.
[2] Aurochs?

impossible from the outset. This is all the more so as it is perfectly possible for the small bones also to be those of domestic pigeons. All one can say with any certainty is that the large bones are not those of rock doves. The great majority of the bones are without doubt those of birds which, with a greater or lesser degree of dependence on the inhabitants, nested in the buildings of ancient Hesban. This provided the opportunity to obtain young birds for the table.

In order to gain some idea of the relative importance of the individual species in terms of human nutrition, we weighed the bones, since bone weight correlates directly with body weight (table 5.14). Since the ratio of bone weight to total body weight or carcass is, in all the species here compared, roughly the same, a weight comparison of this kind may legitimately be carried out, thus revealing the contribution of each species to the diet of the site occupants. It is admittedly impossible to make any absolute statements about the meat quantities actually acquired, since in dealing with buried bones, we have at our disposal only a very small percentage of what was actually thrown away after the animals had been slaughtered and butchered. However, the bone-weight correlations of the different species are nonetheless illuminating. Figure 5.4 shows that sheep and goats, seen from the point of view of their role as providers of meat, no longer enjoy such clear priority. Cattle are almost equally important. We see further that equids and camels, even though they were not at all numerous in the herds of domestic animals owned by the villagers, play a significant role in the provision of meat, simply by virtue of their large body size. Finally, these bone-weight correlations clearly reveal once more the relative importance of the pig in Byzantine times and its relative unimportance in Arabic times.

Now a few remarks on the size of domestic animals. Seen in terms of prehistoric and early historical cattle generally, the cattle of Tell Hesban were of medium size (table 5.15). They were, however, smaller in stature than the modern

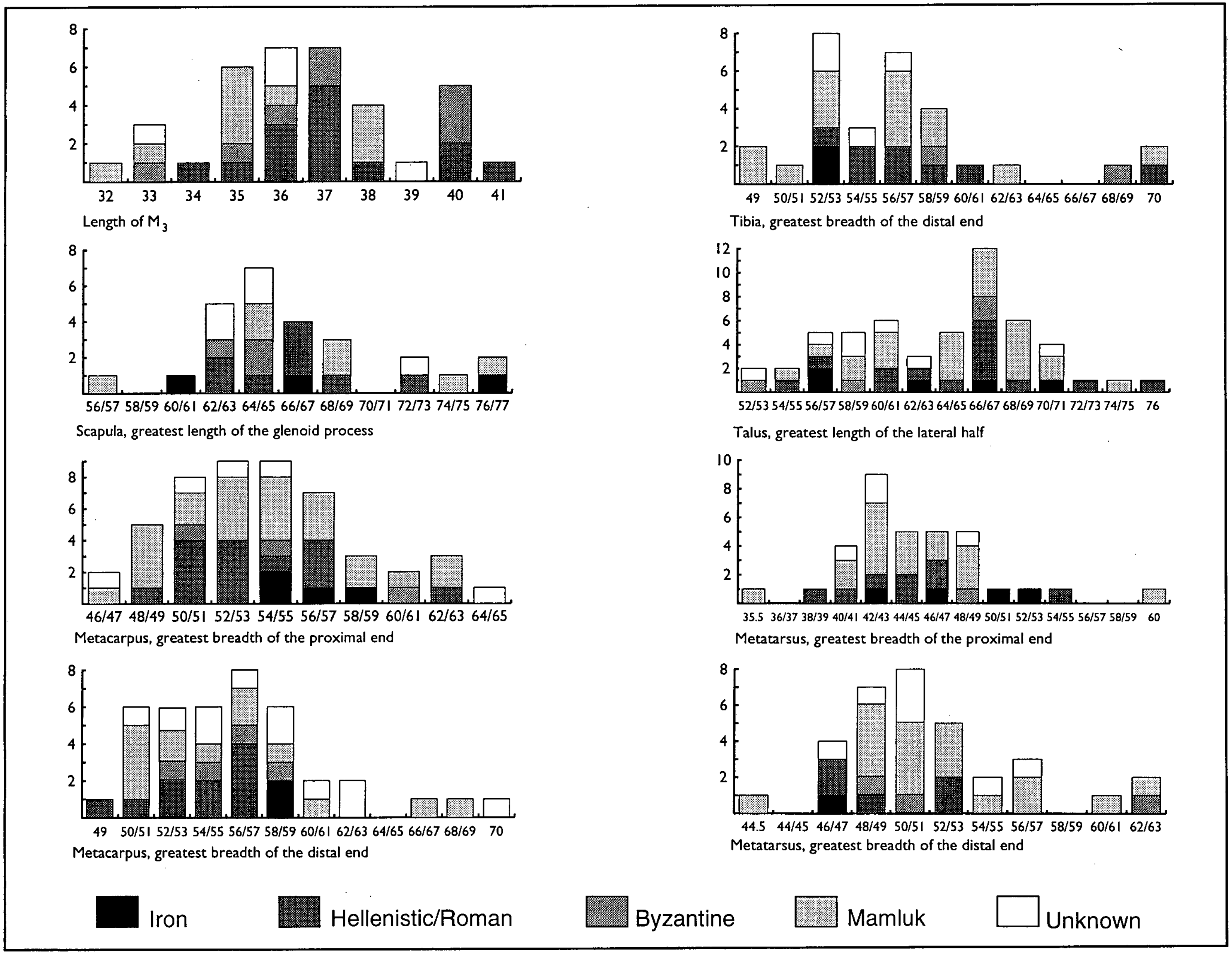
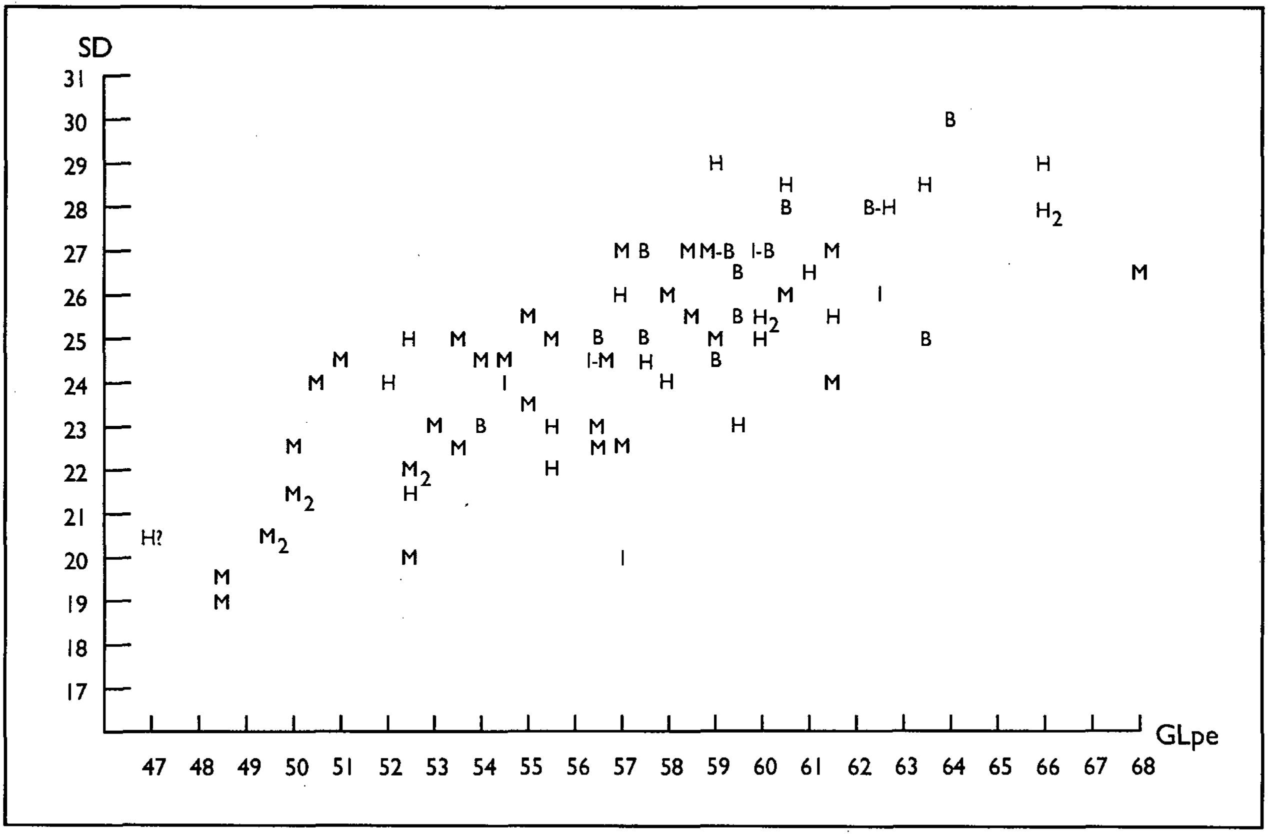


Figure 5.5 Measurements of some skeletal parts of cattle.

Figure 5.6 Cattle: correlation between "greatest length of the peripheral half" (GLpe) and "smallest breadth of the diaphysis" (SD) of the anterior of phalanx 1.

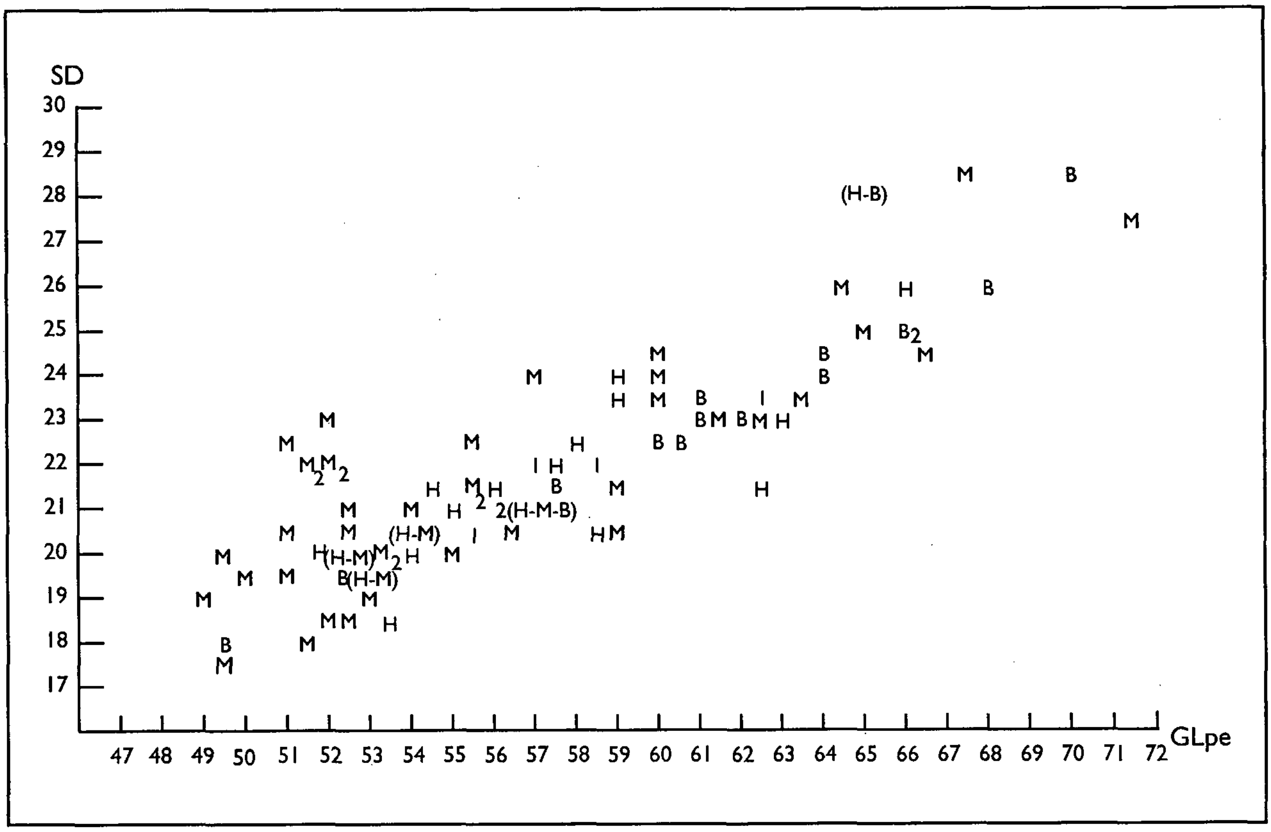


pedigree breeds of Central Europe and North America. From a total of 13 completely preserved metapodia (metacarpi and metatarsi), we calculated heights at the withers of from 1.00 m to 1.25 m for cows and 1.20 m to 1.33 m for bulls and oxen. These dimensions apply in the first instance to cattle of all four epochs. The majority of the bone dimensions indicate that cattle in the Middle Ages were, on the average, smallest, although there occur repeatedly conspicuous examples of particularly large bones from all parts of the skeleton which originate from this period. These could belong to imported zebus (fig. 5.5). The bones of Iron Age cattle frequently do not reach the size of cattle bones from the Hellenistic/ Roman period, whereas those originating from the Byzantine era are on the average the same size as those from the preceding period (fig. 5.5, and Weiler 1981: tables 8, 9). The best illustration of the situation just described is provided by the numerous finds of phalanges (phalanx 1, figs. 5.6 and 5.7; *cf.* also Weiler 1981: diagram 2). This decrease in the size of cattle in the Middle Ages is, as we have already mentioned, an indication that the conditions for cattle-rearing had deteriorated as a result of the increasing overworking of the land by man.

In contrast to that of the cattle, the size of the sheep remained unchanged throughout the whole period under study, if one takes into consideration the dimensions of all bones, not simply those of the completely preserved long bones, from which the height at the withers can be calculated (tables 5.16 and 5.17; and Weiler 1981: table 19). The long bones give rise to the impression that the sheep of the Mamluk period were smaller than those of other periods (table 5.18).

This result is not supported by the dimensions

Figure 5.7 Cattle: correlation between "greatest length of the peripheral half" (GLpe) and "smallest breadth of the diaphysis" (SD) of the posterior of phalanx 1.



of the other bones. The difference in size could be attributable purely to the small number of undamaged metapodia found. Beyond this, one must also take into account that the metacarpi from the Byzantine period exhibit a male/female ratio of 1:2, whereas the complete metacarpi from the Mamluk period are almost all those of ewes.

The variation in the height of the female goats at the withers is also presented in table 5.16. Goats were, by and large, somewhat smaller in stature than sheep. This is true at least of she-goats by comparison with ewes (table 5.17). What size the he-goats reached we are unable to say.

Figures 5.8 and 5.9 illustrate sex dimorphism in the pastern bones (phalanx 1) of sheep and goats, and, in addition, the variation in size of this part of the skeleton and its difference in size compared with the pastern bones of undomesticated ovicaprines (wild sheep, wild goat, ibex). In these figures, the data were not separated according to strata, as there is effectively no difference in size between bones from different individual periods (*cf.* Weiler 1981: tables 19, 20). The ratio between the sexes is, for sheep, female to male approximately 5:1 and for goats, female to male approximately 8:1.

Table 5.19 shows the dimensions of sheep and goat bones which, in terms of their size, do not fit into the general picture. We can say from experience (*e.g.*, Krauss 1975: table 23) that those are from wild sheep and goats. The table also contains the dimensions of ibex bones. The relatively "short" phalanx 1 of the foreleg of a wild goat (GLpe 44, SD 13.5 mm), which in fig. 5.9 does not clearly stand out from the pastern bones of the domestic goats, was found at B.7:27 in association with the distal end of a powerful metacarpus (*cf.* table 5.19 and fig. 5.9), and it is on this, that the

Table 5.16 Sheep and goat: dimensions[1] of completely preserved longbones and height of the animal at the withers (WH, measured in cm; *cf.* Teichert 1975 and Schramm 1967).

a) Humerus

Loc	G.10:14	D.3:57[2]		G.4:22
Strat	17	15?		1
Spec	O	O		O
GL	167	157.5	157.5	156
GLC	151	140	141	139.5
Dp	45.5	45.5	46.3	47
SD	17.5	16.5	16.5	15
Bd	31	34	34.5	33
BT	30.5	32.5	33	30.5
WH	71.5	67.4		66.8

b) Radius

Loc	G.10:2	G.10:1	D.3:57[2]
Strat	16	16	15?
Spec	C	C	O
GL	170[3]	169[4]	167
Bp	31.5	31.5	35.5
BFp	29.5	30	33
SD	18.5	18	18
Bd	29	30.5	32.5
WH	67.7	67.3	67.1

c) Femur

Loc	D.3:57[2]	D.3:57[2]	G.10:1
Strat	15?	15?	16
Spec	O	O	C
GL	188	183	181
GLC	183	178	181
Bp	49.5	44.7	41
SD	-	-	17.5
Bd	41.5	40	40
WH	66.4	64.6	-

d) Metacarpus

Loc	G.12:10	G.10:10	C.2:9	B.1:47	?	D.2:36	D.3:57[2]	A.8:14	D.4:58	D.4:58	?	C.2:9	A.4:53	D.6:35	B.4:205
Strat	9	9	?	15	?	11	15?	2	3	3	?	?	8	8	15
Spec	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
GL	(157.5)	156.5	148	144	141.5	140	138.5	137.5	137.5	136	(136)	135.5	134.5	132.5	132.5
Bp	29	28	28.5	27.5	26.5	25	26	27	26	27	-	27	(28)	27	24.5
SD	17	17	16.5	16.5	15	14	15	15	15	16	15	15.5	17.5	16.5	14
Bd	31.5	31	30.5	(32)	27.5	-	28.5	28	29	29	25.5	29	31.5	-	26
WH	77.0	76.5	72.3	70.4	69.2	68.5	67.7	67.2	67.2	66.5	66.5	66.3	65.8	64.8	64.8

Loc	D.6:33	C.5:3	C.5:3	C.5:3	B.4:179	G.10:10	D.2:95	B.1:47	G.4:43	D.5:5	C.4:10	C.3:12	C.10:4	A.8:1	B.4:59
Strat	4	3	3	3	14	?	15	15	3	3	3	?	2	1-3	13
Spec	O	O	O	O	O	O	C	C	C	C	C	C	C	C	C
GL	132	131	124.5	124	123.5	121.5	117	114.5	(114)	113	112	112	111	108.5	(108)
Bp	24.5	27	25.5	23.5	25	24.5	24.5	24.5	23	24.5	25	23	23.5	-	24.5
SD	14	16.5	14.5	13	14.5	14	15.5	14.5	16	16	16.5	15	14.5	16.5	16
Bd	26.5	29.5	-	(25.5)	29	27	27.7	27.5	28.5	26.5	-	-	27	28	28
WH	64.5	64.1	60.9	60.6	60.4	59.4	67.3	65.8	65.6	65.0	64.4	64.4	63.8	62.4	62.1

Loc	C.6:20	C.4:39	C.4:35	C.1:5	D.1:10	B.1:19	C.5:5	?	C.5:1	C.10:4	D.6:6	?
Strat	2	?	?	3	2-3	15	3	?	2	2	2	?
Spec	C	C	C	C	C	C	C	C	C	C	C	C
GL	107	(107)	106.5	105	105	104.5	103.5	102	102	101.3	101	97.5
Bp	23.5	23.5	24	22.5	22	24	22	22.5	21	24	22.5	22.5
SD	14.7	16.5	16	14.5	13.7	15	14.5	15	15.5	14.8	14	15
Bd	27	27.5	(27.5)	26.5	25	-	-	25.5	24.5	26.8	26	25.5
WH	61.5	61.5	61.2	60.4	60.4	60.1	59.5	58.7	58.7	58.2	58.1	56.1

e) Metatarsus

Loc	D.4:146	D.4:146	C.2:7	?		B.3:72	C.5:3	?	G.3:30	?	C.5:134	C.5:134	G.1:4	A.2:35	C.5:2
Strat	19	19	3	?		13	3	?	13	?	3	3	3	9	3
Spec	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
GL	162.5	162	152	151.5	151.5	151	138	136	(134)	132.5	131.5	131	(131)	129.5	(120)
Bp	23	23	22.5	21	20.7	23.5	-	22	22.5	21.4	22.5	22	-	22.5	-
SD	13.5	13	13	12.5	12	13.2	12	13	14	13	12	12.3	-	11.5	13
Bd	27.5	27	26.5	24	24.5	31.5	(26)	26	-	26.5	26	26	25.5	24.5	25.5
WH	73.8	73.5	69	68.8	68.8	68.6	62.6	61.7	60.8	60.2	59.7	59.5	59.5	58.8	54.5

Loc	A.10:4	D.2:29	C.1:6	C.4:39	C.5:3	B.2:31	A.9:73	B.2:31	C.7:40	C.1:4	C.1:4	?	A.7:1	D.5:5	C.5:50
Strat	1-2	3	3	?	3	11-13	3	11-13	5	3	3	?	1	2	?
Spec	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
GL	(126)	(126)	(125.5)	23	121	(120)	119	119	119	114	114	112.5	112.5	112.5	106
Bp	23	20	-	22.5	23	19.5	20.5	20	20	20	19	19.5	19.5	19	20
SD	13	13	-	14.5	13	12.5	13	13.5	11.7	12	11.5	12	10.5	11.5	11.5
Bd	26.5	25.5	28	26.5	27	24.2	25	24	24	24	23	24	-	22.5	(24.5)
WH	67.3	67.3	67.0	65.7	64.6	64.1	63.5	63.5	63.5	60.9	60.9	60.1	60.1	60.1	56.6

[1] Loc = discovery locus, Strat = archaeological stratum at Tell Hesban, Spec = species; key to the abbreviations of measurements taken from von den Driesch 1976, where: GL = greatest length, GLC = greatest length from caput, Dp = depth of the proximal end, Bp = greatest breadth of proximial end, BFp = greatest breadth of the Facies articularis proximalis, SD = smallest breadth of diaphysis, Bd = greatest breadth of distal end, BT = breadth of the trochlea, WH = height at the withers.

[2] One individual.

[3] GL of ulna = 209.5 mm.

[4] GL of ulna = 210.5 mm.

Table 5.17 Sheep/Goat: dimensional[1] distribution of some of the bones of the extremities; W = wild, O = Ovis, C = Capra.

Scapula

GLP	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42.5
n,O	-	-	-	-	3	1	13	19	24	22	22	14	7	5	2	1
n,C	3	4	7	13	22	22	17	16	10	14	7	5	3	-	-	-

Humerus

BT	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
n,O	-	-	2	6	21	52	36	45	31	9	11	1	1	2	1
n,C	1	3	6	9	18	18	19	15	10	6	4	3	1	1	-

Radius

Bp	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
n,O	-	-	-	-	1	5	9	35	37	22	14	10	6	1	3	-	1
n,C	1	2	8	11	29	24	7	14	6	3	4	4	1	-	-	1	-
																	w

Metacarpus

Bp	21	22	23	24	25	26	27	28	29	30	31	32	33
n,O	1	4	15	35	46	47	36	15	7	1	1	-	-
n,C	3	10	24	23	16	11	7	5	2	1	2	-	1
													w?

Metacarpus

Bd	24	25	26	27	28	29	30	31	32	33	34	35	36	37.5
n,O	3	4	13	34	21	11	4	5	3	-	-	-	1	-
n,C	2	4	14	19	13	2	2	1	-	2	1	1	1	1
										w?	w	w	w	w

Tibia

Bd	22	23	24	25	26	27	28	29	30	31	32	33	34	35
n,O	-	-	-	6	4	38	67	75	47	12	12	1	1	1
n,C	2	12	12	28	22	24	18	12	6	2	-	1	2	1
												w?	w?	w

Talus

GL	26	27	28	29	30	31	32	33	34	35	36	37	38	39
n,O	-	2	5	14	43	45	54	29	14	8	4	2	2	1
n,C	3	3	15	21	23	16	14	9	3	2	1	-	1	-
													w?	w?

Calcaneus

GL	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69
n,O	-	2	1	1	2	2	2	10	7	10	14	12	11	7	3	5	3	2	2
n,C	1	-	2	1	3	2	6	2	7	4	2	1	3	1	-	4	-	-	-

Metatarsus

Bp	17	18	19	20	21	22	23	24	25	26	27
n,O	-	-	1	9	33	43	26	11	5	2	1
n,C	1	5	9	31	16	15	12	8	1	1	3

Metatarsus

Bd	21	22	23	24	25	26	27	28	29	30	31	32
n,O	-	-	2	12	22	36	19	14	2	3	1	1
n,C	2	3	9	19	15	11	5	3	2	1	-	-

[1] Key to the abbreviations of measurements taken from von den Driesch 1976, where: GLP = greatest length of the Processus articularis, BT = breadth of the trochlea, Bp = greatest breadth of proximial end, Bd = greatest breadth of distal end, GL = greatest length.

Table 5.18 Variations in the height at the withers of sheep and goats, calculated from the length of the large longbones.

SHEEP

Period	Variations	x̄	n
Iron	73.6; 73.8	-	2
Hell/Rom	60.4 - 71.5	66.5	12
Byz/Abb	58.9 - 77.0	68.6	5
Ayy/Mam	54.5 - 69.0	63.1	14
?	59.4 - 72.3	65.6	8

GOATS

Period	Variations	x̄	n
Hell/Rom	60.1 - 67.7	64.7	8
Byz/Abb	63.5	-	1
Ayy/Mam	58.1 - 67.3	62.4	21
?	56.1 - 65.7	60.5	8

designation "wild goat" is based. This metacarpus had, as is the case with all other wild goat metacarpi, been hacked off transversely a short distance above the distal condyle. The same is true of the metacarpus of a wild sheep found at the same location. We have interpreted these finds elsewhere as foot bones which had been left in the imported skins of the animals (see also Boessneck and von den Driesch 1978: 272f.).

In the arid zone in which Tell Hesban lies, pigs did not reach any great size. Moreover, many animals did not actually grow to their full size. They were slaughtered as juveniles for economic reasons, as was the normal practice with pigs. The size of the small Hesban pigs of the early historical period is wholly on a level with that of other pigs from the same climatic zone; for example, those from Korucutepe in Eastern Anatolia (Boessneck and von den Driesch 1975: table 25).

Figure 5.8 Ovis: correlation between "greatest length of the peripheral half" (GLpe) and "smallest breadth of the diaphysis" (SD) of phalanx 1 (W = wild sheep).

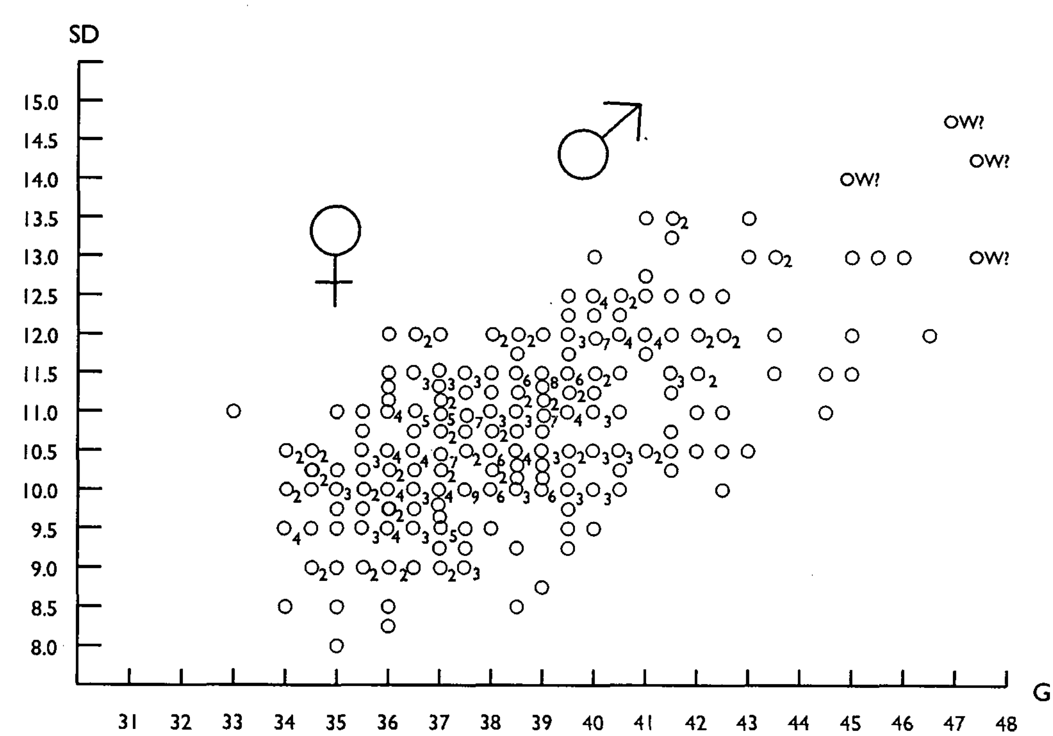
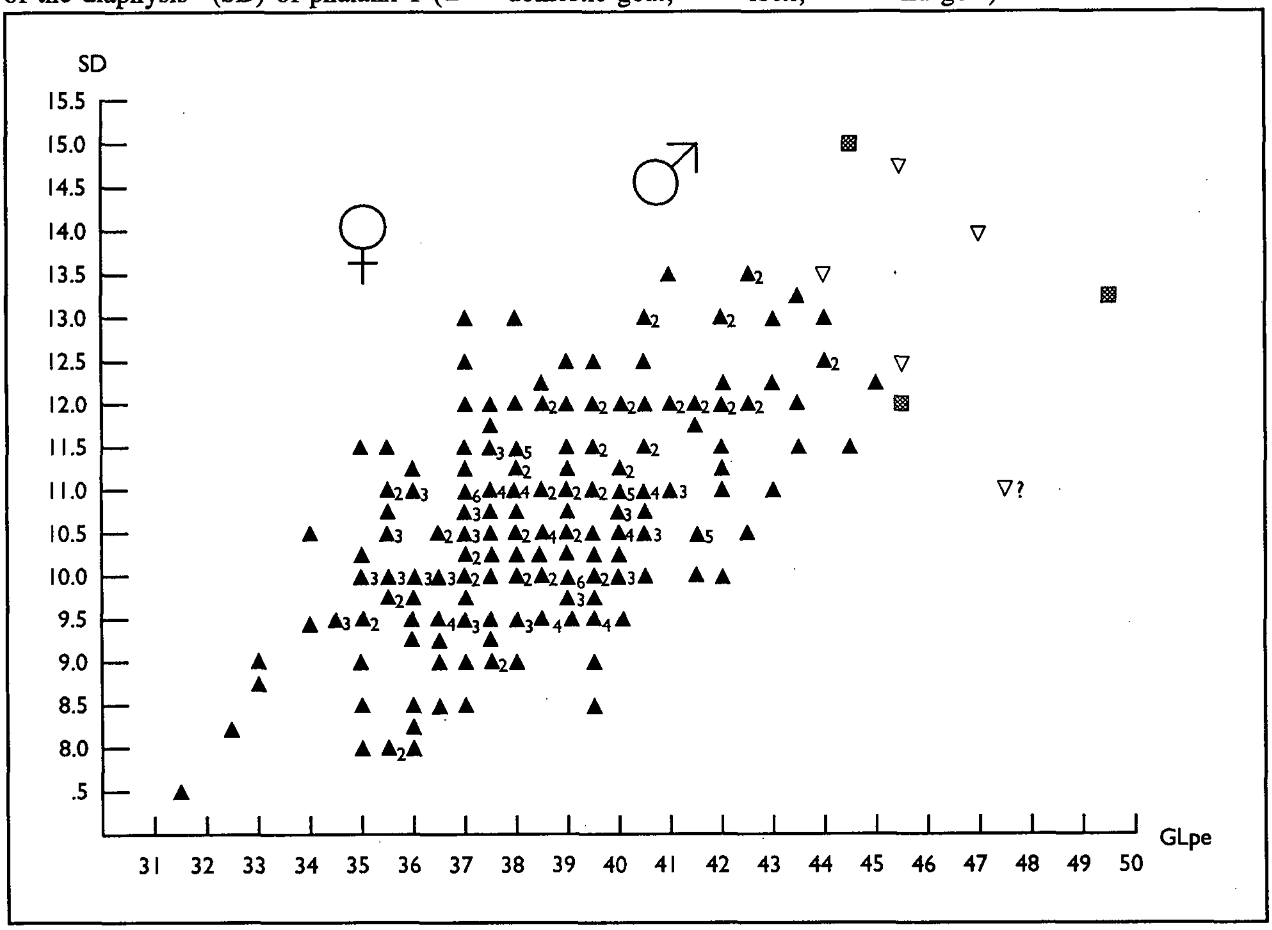


Figure 5.9 Capra: correlation between "greatest length of the peripheral half" (GLpe) and "smallest breadth of the diaphysis" (SD) of phalanx 1 (▲ = domestic goat, ▣ = ibex, ▽ = wild goat).



The assessment of the size of horses and asses is made difficult, on the one hand, by the presence of mule bones, not every one of which can be identified as such; on the other, by the presence of remains of a wild equid, the Syrian onager, which is the smallest of the subspecies of the Asiatic wild ass, the *hemion*. The finds were classified on the basis of their size and form. Three groups could be distinguished: large bones (horse); small, slender bones (ass, and possibly onager); and an intermediate size (mule). In their detailed morphology, some of the bones of the intermediate group more closely resemble the bones of the horse; others, those of the ass. This is typically the case when dealing with a hybrid of two closely-related species. In the case of the small, delicate equid bones, one must, as we have said, consider the possibility that they belong to the Syrian onager. There is every likelihood that this species had spread as far as the Plateau of Moab in early historical times. This wild equid, of which the range of individual variations is insufficiently known, possesses strikingly long metapodia and slender pastern bones. However, these are difficult to distinguish from those of the domestic ass which in Palestine is relatively slender of stature because of the arid climate. Detailed comments in this problem can be found in Turnbull and Reed (1974: 107), Davis (1980a), Boessneck and Kokabi (1981), von den Driesch and Amberger (1981; *cf.* also Clutton-Brock and Burleigh 1978; Rauh 1981).

Table 5.20 shows the dimensions of metapodia (front and rear cannon bones), which were preserved in their entire length. The correlation between the GL and SD of the pastern bones of the Equids, as shown in fig. 5.10, includes finds suspected as belonging to the onager. In addition, we refer readers to Weiler's comments on the

Table 5.19 Dimensions[1] of the bones of wild sheep (*Ovis orientalis*), wild goat (*Capra aegagrus*), and ibex (*Capra ibex nubiana*).

a) Scapula

Loc	C.5:5	C.2:9	D.4:117
Strat	3	?	13
Spec	C.n	C.n	C.n
SLC	26	25	24
GLP	-	41	42.5
LG	-	33	33
BG	-	26	28.5

b) Humerus

Loc	B.2:83	C.5:153
Strat	15	3
Spec	C.n	C.n
Bd	44.5	-
BT	42	39

c) Radius

Loc	A.4:12
Strat	11
Spec	O.a.
Bp	42
BFp	37

d) Metacarpus

Loc	B.7:27[2]	B.1:37	B.7:27[3]	B.4:16	B.7:27
Strat	11	15	11	3	11
Spec	O.a.	C.a.	C.a.	C.a.	C.a.
Bd	36.5	37.5	36	35	34

to Phalanx 1

e) Tibia

Loc	B.1:18	C.5:70
Strat	15	6
Spec	O.a.	C.a.
Bd	35	35.5

f) Talus

Loc	B.1:47
Strat	15
Spec	O.a.
Bd=BC	26.5

g) Phalanx 1

Loc	C.8:44	A.2:43	C.8:189	C.5:64	B.7:27	B.4:16	A.2:25	C.1:136
Strat	3	12	17	6	11	3	11	18
Spec	C.a.	C.a.	C.a.	C.a.	C.a.	C.n.	C.n.	C.n.
GLpe	47.5	47	45.5	45.5	44	49.5	45.5	(44.5)
Bp	13.5	16.5	15	17	16	15.3	14.5	16
SD	11	14	12.5	14.7	13.5	13.2	12	15
Bd	12.5	15.5	14.5	17	16.2	15.2	15.2	17.5

to Metacarpus

[1] Loc = discovery locus, Strat = archaeological stratum at Tell Hesban, Spec = species; key to the abbreviations of measurements taken from von den Driesch 1976, where: SLC = smallest length of Collum scapulae, GLP = greatest length of Processus articularis, LG = length of glenoid cavity, BG = breadth of the glenoid cavity, Bd = greatest breadth of distal end, BT = breadth of the trochlea, Bp = greatest breadth of proximial end, BFp = greatest breadth of the Facies articularis proximalis, GLpe = greatest length of the peripheral half, SD = smallest breadth of diaphysis.

[2] *Cf.* pls. 5.1a and 5.1b; Boessneck and von den Driesch 1978: pl. 22.

[3] *Cf.* pl. 5.1a; Boessneck and von den Driesch 1978: pl. 22.

subject (1981: 133-142).

Whether the camel finds from Tell Hesban are the bones of the dromedary or of the bactrian camel is something which, morphologically, could not be determined with a sufficient degree of certainty (see Weiler 1981: 159ff. and diagrams 11 and 12). According to Zeuner (1967: 288), the large long bones of the bactrian camel are shorter. Bones for morphological differentiation are the cranium (Lesbre 1903), atlas, and some limb bones (Wapnish 1984).[2] In the Tell Hesban material, however, the bones are present only as fragments and, so, did not form the basis of any judgment.

The Romans used the bactrian camel in the Middle East as a pack animal and as a

Table 5.20 Dimensions[1] of finds of equid metapodials.

a) Metacarpus

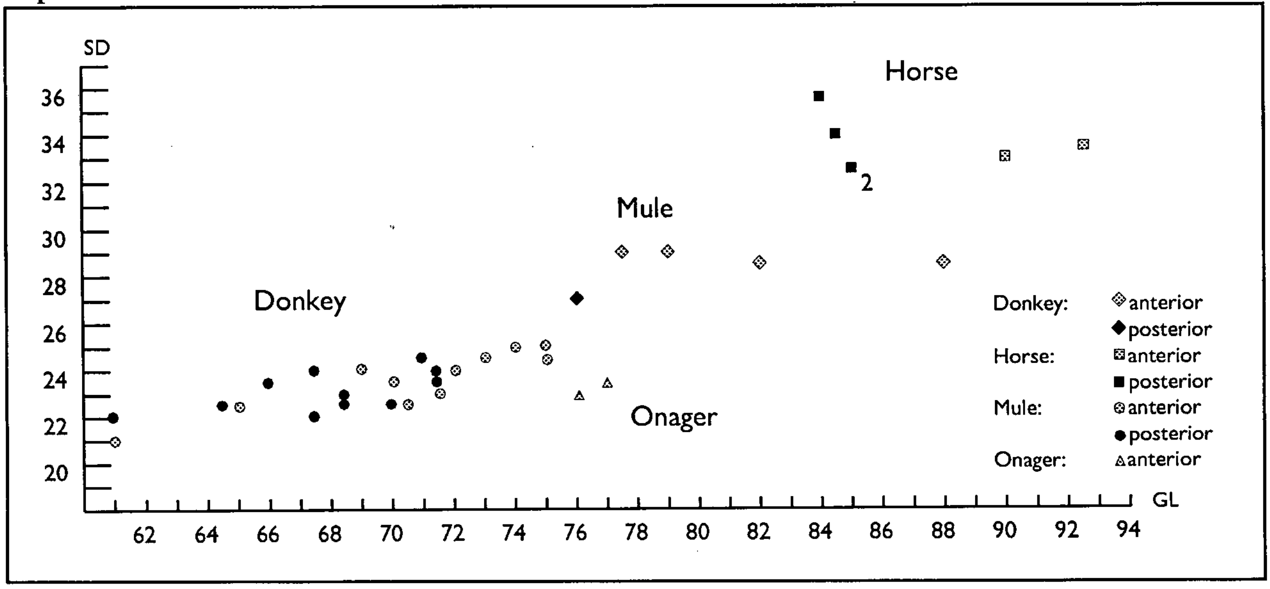
Loc	B.1:94	D.4:1	B.1:100	C.5:90	C.1:6	C.1:6	?	C.4:1	C.5:143	C.5:4	A.3:69
Strat	15	2	15	10	3	3	?	2	13	3	8
Spec	Horse	Horse	Mule	Mule	Ass	Ass	Ass	Ass	Ass	Ass	Ass
GL	(223)	222.5	(199)	195	191.5	185.5	175	173.5	(173.5)	168	167.5
GLl	219	219	198	193.5	190.5	185	173.5	172.5	-	-	166
Ll	213.5	214	194	193.5	188	180.5	171	169.5	-	-	162.5
Bp	-	51.5	43.5	44	(43.5)	40.5	35	35	41	30.5	(34)
SD	33.8	37	29.5	29	25.5	25.5	22.5	24	25	21.5	23.5
Bd	49.5	(50)	42.2	40	36.2	35	33	31.5	-	-	32
$I = \frac{SD \times 100}{GL}$	15.2	16.6	14.8	14.9	13.3	13.7	12.9	13.8	14.4	12	14

b) Metatarsus

Loc	A.6:30	?	C.4:7	D.3:100	G.12:1	C.2:7
Strat	4	?	3	?	1	3
Spec	Onager?	Onager?	Onager?	Ass	Ass	Ass
GL	239	235.5	232	225.3	(224)	209.5
GLl	236.5	234	230.5	(225)	-	208.3
Ll	233.7	232.5	227.7	220.5	-	206
Bp	37.8	37.5	38.3	36	-	33.2
SD	24	23.3	23.3	23	23	21.5
Bd	35.5	37	34.7	33.5	(33.5)	33.7
$I_1 = \frac{Bp \times 100}{GL}$	15.8	15.9	16.5	16	-	16.1
$I_2 = \frac{SD \times 100}{GL}$	10	9.9	10	10.2	10.3	10.3

[1] Loc = discovery locus, Strat = archaeological stratum at Tell Hesban, Spec = species; key to the abbreviations of measurements taken from von den Driesch 1976, where: GL = greatest length, GLl = greatest length of lateral part, Ll = length of lateral part, Bp = greatest breadth of proximial end, SD = smallest breadth of diaphysis, Bd = greatest breadth of distal end.

Figure 5.10 Equids: correlation between "greatest length" (GL) and "smallest breadth of the diaphysis" (SD) of phalanx 1.



mount for dispatch riders, whereas Roman camel regiments probably made use only of the dromedary (Keller 1887: 37). Camel finds in Central Europe lead one to the assumption that the Romans took with them camels apparently of both species over a wide area of their activities. Presumably, however, the Tell Hesban finds are all of the dromedary, which today is the only species of camel found in Jordan. Walz (1952: 196) names Mesopotamia as the area where the two species overlap. There is never any mention of the bactrian camel in descriptions of finds in Palestine (Isserlin 1950-51; Clutton-Brock 1979: 146). The camel bones of Tell Hesban do not differ in size from those of dromedaries bred nowadays in Jordan, a fact which was established by means of comparisons with bones collected on the spot.

While there is considerable variation in the size of the dog bones found, the great majority points to dogs of medium to slightly above medium size (45 to almost 60 cm height at the shoulder; Weiler 1981: table 36). As the bones are slender in form, the possibility cannot be ruled out that a number of them are those of the jackal. Worthy of remark are the remains of the cranium of a toy dog found at C.8:34. We have already drawn attention to this find elsewhere (Boessneck and von den Driesch 1978: 266). Initially, it was classified as early Roman. However, in the light of the latest discoveries, the location should be regarded as "probably Mamluk." Nonetheless, toy dogs were already popular in Roman times (*cf. e.g.*, Boessneck 1958: 106ff.).

The cats were small animals, as is still the case in Hesban today. Lindner's metrical studies of chicken bones (1979) have shown that chickens were larger in the Hellenistic/Roman period than in Byzantine and Mamluk times.

Wild Mammals

The list of wild mammals (tables 5.2 and 5.21) includes at least 32 species. As far as the larger species are concerned, the wild fauna of ancient times which lived in the immediate or more distant surroundings of the tell during the course of its settlement is almost completely represented. However, the list also includes species of animals whose presence one would not at all have expected. For example, Nubian ibex bone finds had been reckoned with, since the area around Tell Hesban is part of the natural range of this wild ruminant (Harrison 1968: fig. 154). The same is not true, however, of the wild goat (fig. 5.11), of which several foot bones and the distal end of a tibia were found (table 5.19 and pl. 5.1). The most southerly habitat in the Middle East of this mountain animal, which is closely related to the Nubian ibex and

Table 5.21 Summary of wild mammal finds (excluding small mammals) and the periods to which they are assigned (1968-1976).

Species	Ayy/ Mam	Byz/ Abb	Hell/ Rom	Iron	?	Total
fallow deer	3	-	37	7	4	51
red deer	3	-	-	-	1	4
?aurochs	2	1	3	1	1	8
gazelle	165	20	86	16	44	331
arabian oryx	-	1	-	-	-	1
nubian ibex	7	1	3	1	2	14
wild goat	-	1	4	-	-	5
wild sheep	-	1	6	1	-	8
wild boar	87	20	24	2	6	139
syrian onager	2	-	3	-	1	6
rock hyrax	-	1	-	-	-	1
?grey wolf	-	1	-	-	-	1
fox	58	7	6	-	13	84
?sand fox	-	-	-	-	6	6
badger	5	-	1	2	-	8
ratel	-	-	-	-	1	1
weasel	-	4	26	2	-	32
marbled polecat	-	2	6	1	1	10
beach marten	-	-	1	1	1	3
mongoose	-	-	-	1	-	1
striped hyena	6	-	-	1	-	7
wild cat	1	1	-	-	-	2
lion	-	-	1	-	1	2
leopard	1	-	-	-	1	2
cape hare	23	2	1	1	3	30
Old World porcupine	1	-	-	-	-	1
Total	364	63	208	37	86	758

Figure 5.11 Wild goat, *Capra aegagrus* (after Vinogradov *et al.* 1953: 250).

easily mistaken for it, had previously been established as being the Mountains of Palmyra (Harrison 1968: fig. 156). Up to the present, there had been no proof whatsoever of its presence in the mountains near the Dead Sea.[3] On the basis of careful osteological comparison, the bones in question could, however, be positively identified as being those of the wild goat. It can safely be assumed that we are not dealing here with bones of the closely related ibex. Unless one is prepared to accept that the wild goat was formerly to be found farther south than previously believed, then the only remaining explanation for the presence of these bones, which are exclusively foot bones, is that they were imported in the course of the trade in skins and hides. In some parts of Switzerland, people use a method of skinning goats in which the horns and lower parts of the legs remain on the hide (Schmid 1969: fig. 5). Such an interpretation is rendered plausible by the fact that in the case of the wild goat bones from Tell Hesban, only the lower parts, the distal end of one tibia, the transversely hacked off distal ends of several metacarpi (pl. 5.1), and a number of phalanges (table 5.19) were found. Hesban lay from time immemorial on an important north-south trade route. As early as the period of Stratum 16, it was a trading center on the "Kings Highway." There is, thus, historical support for the possibility that animal hides were imported.

This interpretation would also help to account for the presence in the bone sample of a transversely severed talus and the distal end of a

Plate 5.1 Transversally cut-off foot bones of a) wild goat (metacarpus, B.7:27), b) maral (talus, distal half, D.2:44), and c) maral (metatarsus, D.4:1).

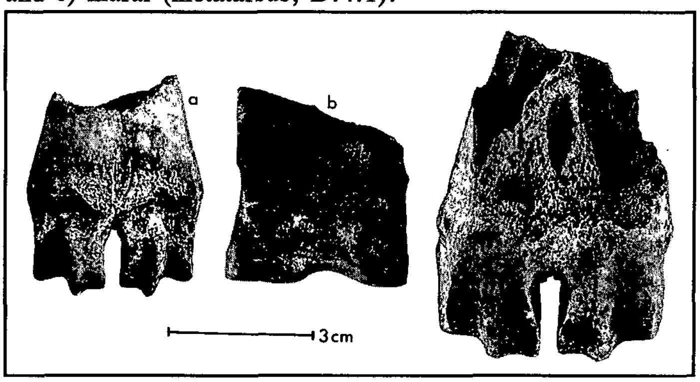
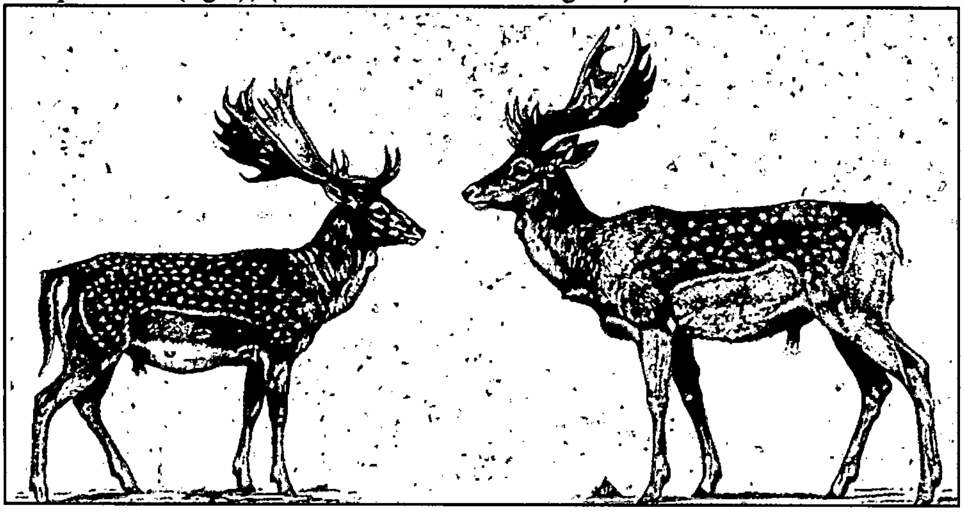


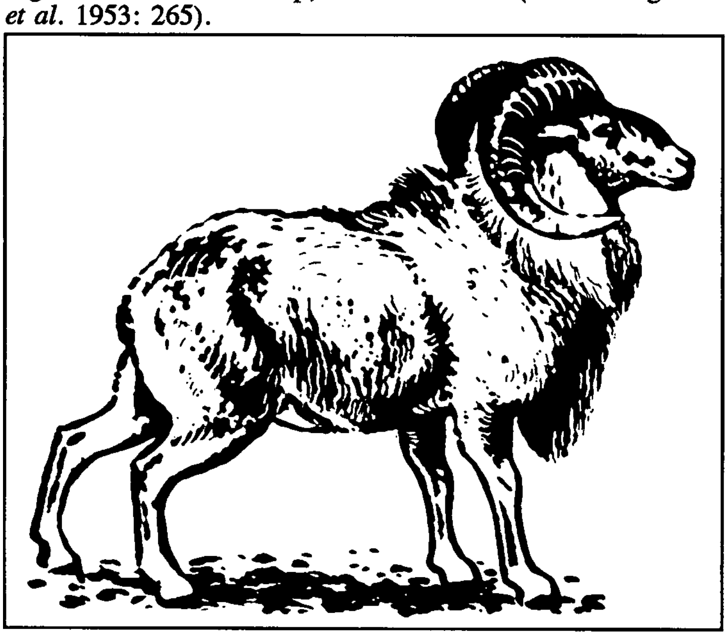
Figure 5.12 European, *Dama dama* (left), and Persian fallow deer, *Dama mesopotamica* (right), (after Haltenorth 1959: fig. 46).



metatarsus of the maral, a large oriental variety of red deer (pl. 5.1). The red deer had long since ceased to belong to the indigenous fauna of Jordan. It disappeared at the end of the Mesolithic or at the beginning of the Neolithic period as a result of climatic changes (Boessneck and von den Driesch 1977: 50); whereas the real indigenous deer of Jordan, the Persian fallow deer, which differs clearly from its closest relative, the European fallow deer, in size and in the form of its antlers (fig. 5.12), became extinct only within the last hundred years, as a result of excessive hunting and the destruction of its natural habitat (see also Boessneck and von den Driesch 1977).

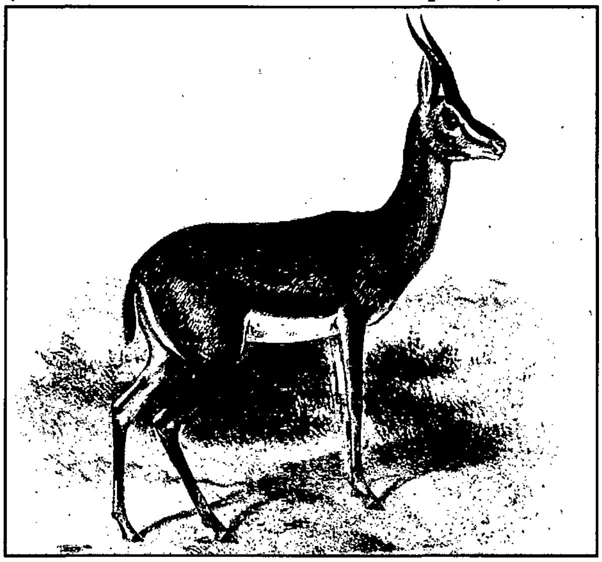
A third species of hooved animal is an equally unlikely member of the faunal community which one might otherwise have expected to find represented in the bone finds from Tell Hesban, namely the wild sheep (fig. 5.13). According to a distribution map published by Harrison (1968: fig. 157), wild sheep lived much farther to the north. The osteological identification is just as certain as in the case of the wild goat. However, in the case of the wild sheep, unlike those of the wild goat and the red deer, it is not so easy to uphold the theory of trade in skins and hides, inasmuch as bones were found which derived from parts of the meat-rich portions of the skeleton (table 5.19). The animals must, therefore, have been killed in the close vicinity and brought in carcass form to the tell. The range of the wild sheep (like that of the wild goat) may possibly have extended as far as the Dead Sea in prehistoric times. At the present stage of our investigations, however, this cannot be proved definitively, owing to a lack of relevant zoological analysis of bone finds in the area.

Figure 5.13 Wild sheep, *Ovis orientalis* (after Vinogradov *et al.* 1953: 265).



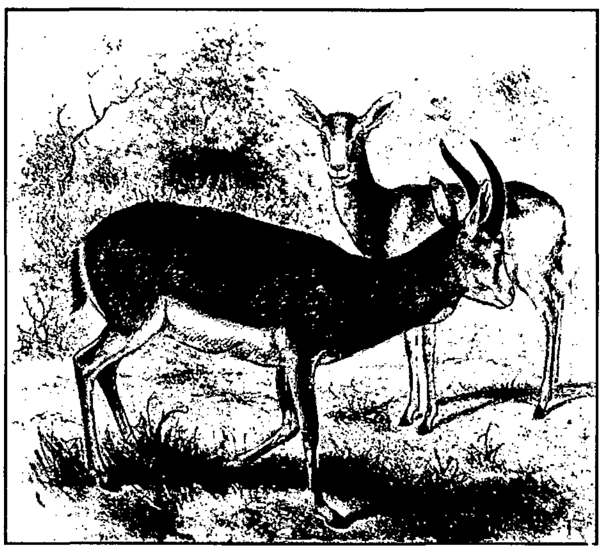
The problem posed by the presence of a particularly large cattle metacarpus (C.3:12, undated) was discussed in some detail in our preliminary report (1978: 273, 1981: 64; see also fig. 1). With a maximum length of *ca.* 238 mm, maximum proximal width of 64 mm and a smallest width of diaphysis of 34 mm, it has the characteristics of a bone of the female aurochs, *Bos primigenius*. The extreme end of the distal condyle has been transversely hacked off. It is difficult to assign this metacarpus, which

Figure 5.14 Mountain gazelle, *Gazella gazella* (after Sclater and Thomas 1897/98: pl. 59).



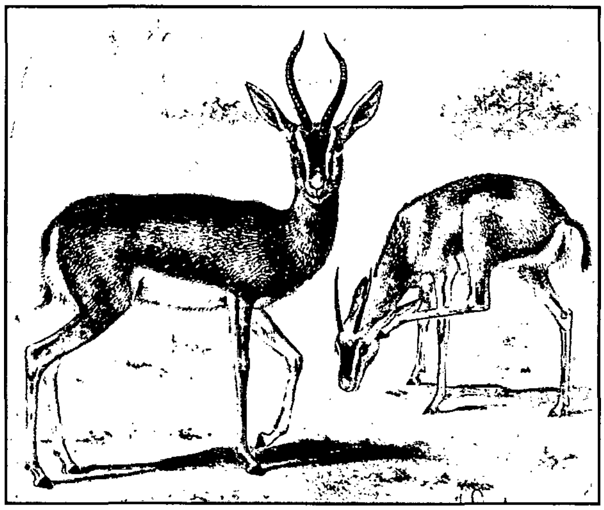
was initially dated as belonging to the Ayyubid/Mamluk period, to an animal of the Middle Ages, as the cattle of that time did not grow to a particularly great size. Moreover, the bone is too large even for a zebu, the presence of which in medieval Hesban must be reckoned with. It also surpasses in size even the largest cattle metacarpi which are known from the Roman period in Central Europe (Boessneck *et al.* 1971: diagrams XXXII and XXXVII). According to the latest suggested datings, however, the find could just as well originate from the Iron Age. If this is the case, then the bone may be assigned without hesitation to a female aurochs; and we may assume the occurrence of this species of wild cattle, the progenitor of our domestic cattle, in the area around Tell Hesban (*cf.* Weiler 1981: 41).

Figure 5.16 Persian gazelle, *Gazella subgutturosa* (after Sclater and Thomas 1897/98: pl. 55).



The great bulk of the sample of wild mammals is made up of the bones of gazelles (table 5.21). These present us with even greater difficulties with regard to precise species determination. The land around Tell Hesban is part of the natural range of two to three species of gazelle. Apart from the mountain gazelle, *Gazella gazella*, which is native to the mountains of Palestine (Groves 1969: 54 and fig. 1; Lange 1972: 227 and fig. 8), there is the

Figure 5.15 Dorcas gazelle, *Gazella dorcas* (after Sclater and Thomas 1897/98: pl. 57).



Dorcas gazelle, *Gazella dorcas* (Haltenorth and Diller 1977: 99; Lange 1972: 215f. and fig. 6; Kumerloeve 1967: 337), and possibly also the Persian gazelle, *Gazella subgutturosa* (Groves 1969: 48 and fig. 2; Lange 1972: 322ff. and fig. 9; Harrison 1968: 362 and fig. 165).

With gazelles, it is differences in the form and size of the horns which are of great importance in species differentiation (figs. 5.14, 5.15, and 5.16). Identification on the basis of the post-cranial skeleton is not yet possible. The identification of horn-core finds reaches its limitations at the point where there is a lack of suitable material for comparison. This applies in the present instance to the mountain gazelle, for which no measurements suitable for comparison could be found in the literature, either. The problem is exacerbated by the fact that the Mountain gazelle and the Persian gazelle grow to about the same size, whereas the Dorcas gazelle is the "smallest and most delicate" (Lange 1972: 215). In all gazelles there is a clearly marked sex dimorphism, which finds expression in the size of the bones. In the light of all this, differences in the form of the horns take on a particular significance. We shall, therefore, go briefly into detail on the matter.

The horns of the male Dorcas gazelle are curved in the form of a lyre (fig. 5.15), and have numerous transverse protuberances (Haltenorth and Diller 1977: 98). Seen from the side, they are bent in the form of an "S." The horns of the females are straighter and not as strong. The mountain gazelle can be distinguished by the steeper angle of its horns, which have fewer and more widely spaced transverse protuberances (Lange 1972: 227). The male Persian gazelle, which is equal in size to, or larger than, the mountain gazelle, has horns which spring from points close together at the skull and then diverge very markedly, thus accentuating the lyre shape (Harrison 1968: 359). The females are either without horns or have only stumps. The great majority of the gazelle horn cores found at Tell Hesban display characteristics typical of *G. gazella* (*cf.* pl. 5.2 a-c with Davis 1980b: fig. 1). They are exclusively from males. Two horn cores could be identified on the basis of comparisons with other material, as belonging to *Gazella dorcas* (pl. 5.3). There was no clear-cut identification of

Plate 5.3 Horn core of *Gazella dorcas* from Tell Hesban (B.1:143).

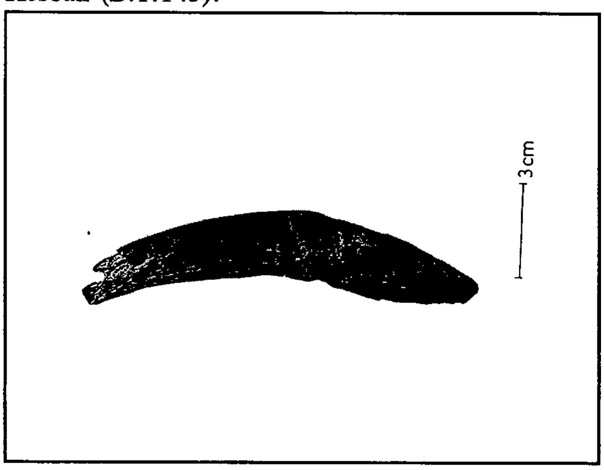
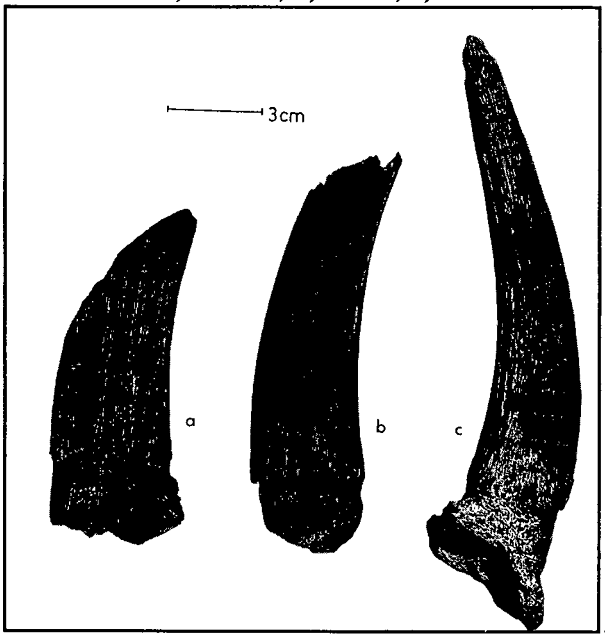


Plate 5.2 Horn cores of *Gazella gazella* from Tell Hesban: a) C.3:44; b) C.2:?; c) D.6:33.

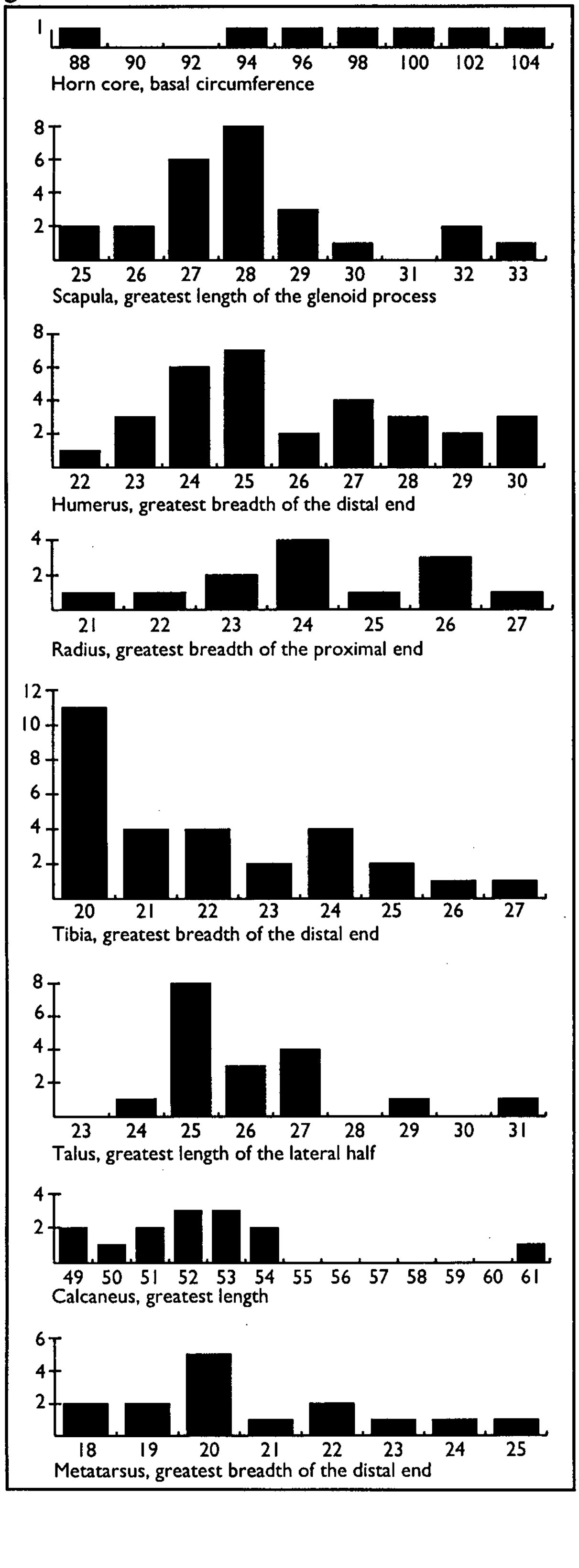


horn cores of *Gazella subgutturosa* (*cf.* also Weiler 1981: 42ff.).

The post-cranial gazelle bones can be divided on the basis of their size into three more or less distinct groups (figs. 5.17 and 5.18). The smallest bones are probably those of Dorcas females. The medium-sized bones, which numerically form the largest group, are presumably those of male Dorcas gazelles and of females of the two larger species. The largest finds are those of male Mountain gazelles and perhaps also of male Persian gazelles (*cf.* also Davis 1980b: fig. 2 and table 1).

The quantitative proportions in which the bones of the fallow deer and of gazelles are represented (51:331) throw some light on the biotope of ancient times. Deer are typical inhabitants of forest and jungle, whereas gazelle are equally typical inhabitants of steppe and desert regions. The predominance of gazelles among the wild fauna of the Hesban region suggests that the surrounding countryside has been open since ancient times. Fallow deer could live only in those regions where there were thickets, as they require a more lush habitat. These animals must have established themselves along the wadis and the valley of the Jordan, where water flows throughout the entire year. The wild boar lived in the same habitat as the

Figure 5.17 Size comparison of post-cranial gazelle bones.



fallow deer. In terms of bone material found, it is the most abundant large wild mammal after the gazelles. It is interesting to note that, during the Middle Ages, at a time when the consumption of pork was increasingly proscribed, the wild boar was hunted with the same intensity as in the preceding periods (table 5.21). Plate 5.4 represents a hunting scene showing wild boar, a detail of the mosaic uncovered in August 1976 at the church on Mt. Nebo.

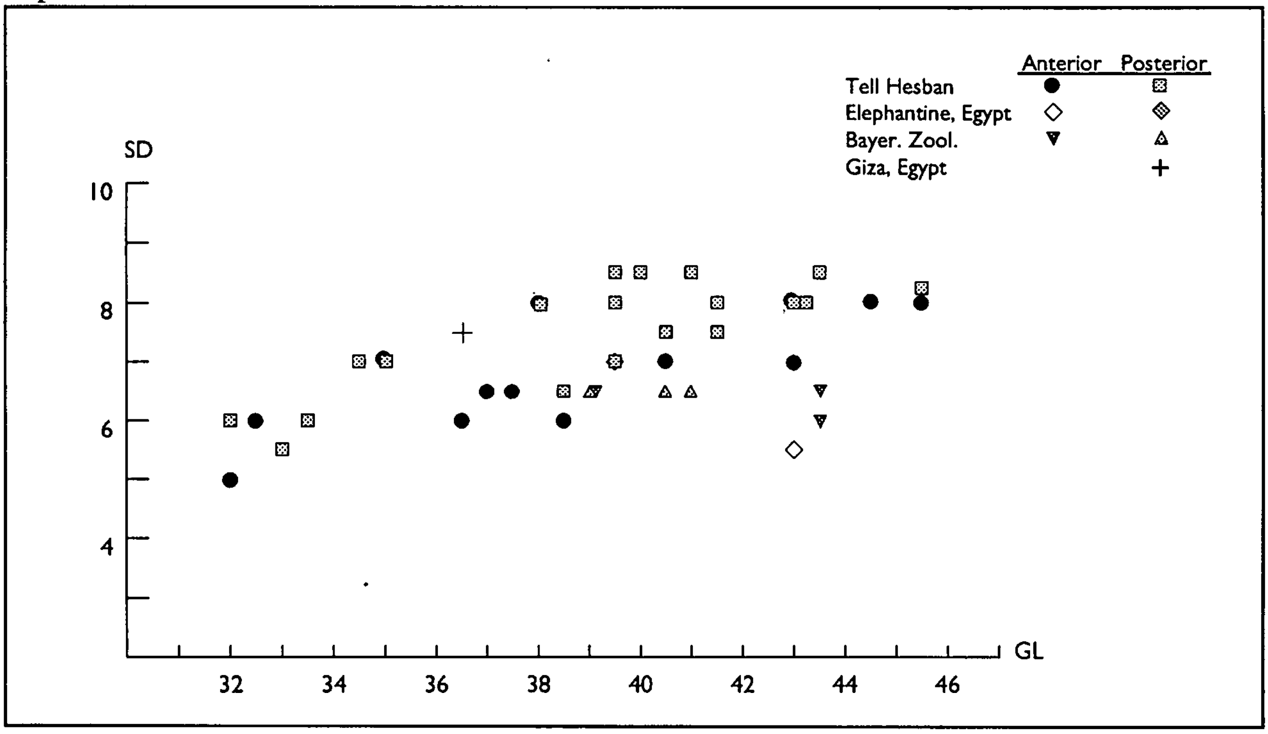
Not all of the species of mammals listed in tables 5.2 and 5.21 are animals which the inhabitants of the Tell Hesban area enjoyed hunting and from which they obtained meat, skins and hides (or leather), and horns and antlers, from which they could make tools. Some of the small mammals, such as the rat and the house mouse, are commensal forms of life which live in houses and die there. This accounts for the presence of their bones in the archaeological strata. Other small animals need not necessarily have lived on the Tell during the period of man's occupation at all. They may well have lived at a later date and, in pursuance of their natural habits, intruded into the strata and died there. Ehrenberg's mole rat is the most abundant small mammal found on the tell. It is quite small, burrows down to a depth of 2 m and more, and spends its life underground. It is scarcely necessary to emphasize the detrimental effects for archaeology which the habits of such an animal can have.

> At Jarmo in Iraq, Reed found burrows in use to a depth of 75 cm in his archaeological test pits, and commented on the nuisance caused to archaeologists as a result of displacement of objects from their correct stratification resulting from thousands of years of spalax activity. (Harrison 1972: 440)

An immense quantity of bone finds, such as that obtained from Tell Hesban, is necessary if the sample is to include rarer species of animal and those which were hunted only on occasion. In the following paragraphs, we will discuss a number of these rarer species, many of which are represented in the finds by only a single bone. In one of the last sets of finds which we examined, we found a fragment of the horn core of an Arabian oryx (D.3:7, Stratum 3), an inhabitant of steppe and desert which formerly occurred throughout the whole of Arabia. Today it is practically extinct in the wild (fig. 5.19).

The rock hyrax, *Procavia capensis*, too, is represented in the finds by only a single bone.

Figure 5.18 Gazelle: correlation between "greatest length" (GL) and "smallest breadth of diaphysis" (SD) of phalanx 1.



The fact that only one bone of this inhabitant of rocky terrain, the "shafan" of the Bible (Bodenheimer 1960: 49), was found can be ascribed to its small size, but not, as is the case with the oryx, to its rarity. It corresponds in size to the wild rabbit. For this reason the Phoenicians, when they came to Spain, confused the indigenous wild rabbit with the rock hyrax. It is said, indeed, that Spain owes its name to this error:

Plate 5.4 Hunting scene with wild boar. Detail of mosaic in the church of Mt. Nebo, Jordan.

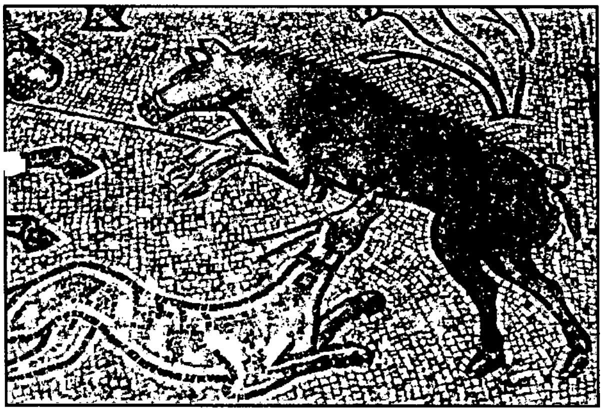


Figure 5.19 Arabian oryx, *Oryx leucoryx* (after Sclater and Thomas 1899/1900: pl. 82).

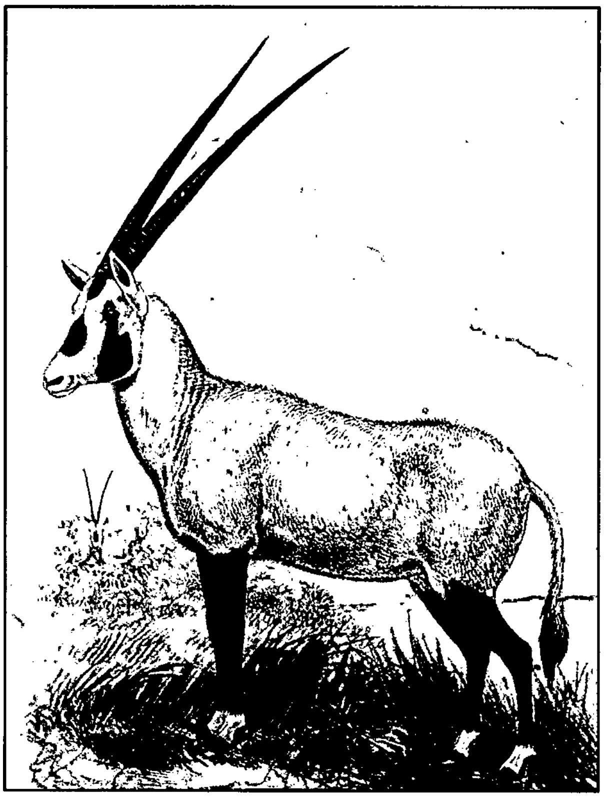


Figure 5.20 Rock hyrax, *Procavia capensis* (after Tristram 1884: pl. 1).

"Hispania" means "country of hyraxes" (Zeuner 1967: 343). For the benefit of the zoological layman, it may be added that this small animal, rodent-like in appearance, is distantly related to the elephant! It is not a rodent, but an ungulate.

Another reason why the hyrax is not present in the finds in greater numbers is that we have here an animal found only in a particular environment, namely, steep rocky cliffs with natural crevices. The weasel, which is the smallest predatory animal identified on Tell Hesban and much smaller than the hyrax, on the other hand, occurs relatively frequently (32 finds) in the sample (table 5.21). It does not avoid the vicinity of human dwellings, provided that it finds sufficient prey there, the mice and rats on which it lives. A species closely related to the weasel is the marbled polecat (fig. 5.21).

Figure 5.21 Marbled polecat, *Vormela peregusna* (after van den Brink and Haltenorth 1968: pl. 14.5).

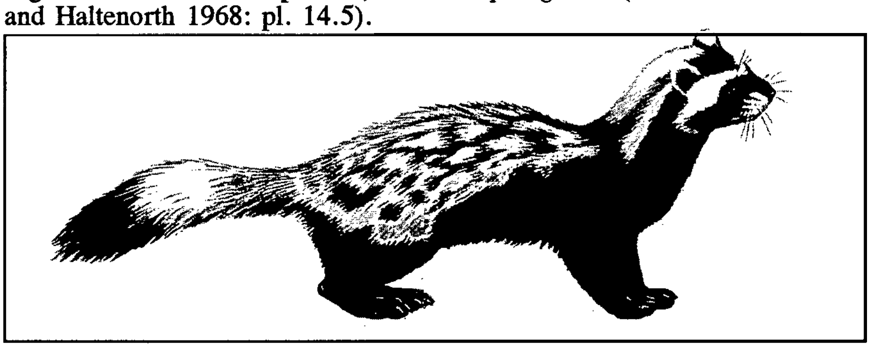
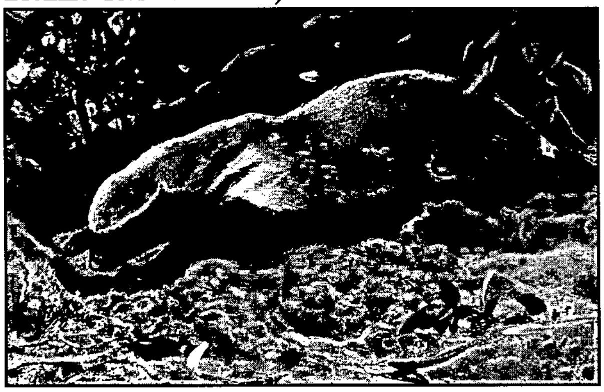
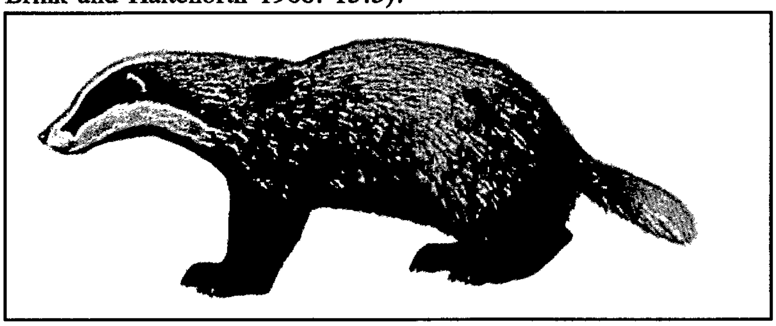


Figure 5.22 Ratel, *Mellivora capensis* (after Brehms Tierleben 1915).



Apart from the lion and the leopard, which require no further discussion, other predatory animals present only in small numbers in the finds include two closely related species of mustelid, the honey badger or ratel, *Mellivora capensis* (fig. 5.22) , and the common badger, *Meles meles* (fig. 5.23). The former is more

Figure 5.23 Badger, *Meles meles canescens* (after van den Brink and Haltenorth 1968: 15.5).



heavily built than the latter and possesses striking markings. The entire ventral surface is black. There is a sharp division between the black underparts and the white dorsal mantle, which begins as a curved line on the forehead. We had some difficulty in obtaining comparative skeletal material from this species in order to prove our contention that one of the femora found was not from the related common badger, which is more commonly represented in the bone finds of Tell Hesban.

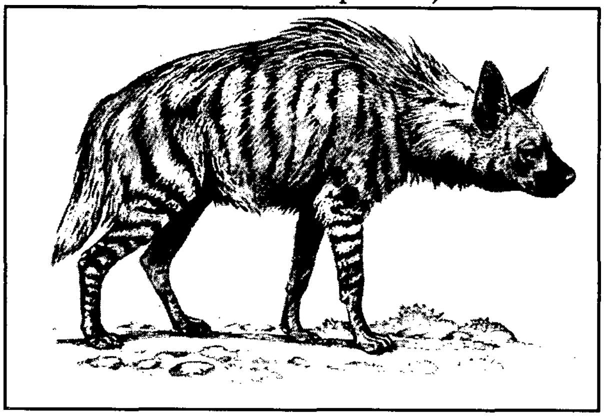
The appearance of the ichneumon (mongoose), *Herpestes ichneumon*, a predatory animal only slightly smaller than the badger, is shown clearly in fig. 5.24. "The mongoose (*Herpestes ichneumon*), is often mentioned as an Egyptian animal since Herodot, mainly as the cunny enemy of the crocodile and of its eggs" (Bodenheimer 1960: 45). Palestine is part of the natural range of this animal.

Of all the predatory animals represented in the finds, the fox, *Vulpes vulpes*, with 84 items, is the most numerous. This is scarcely surprising. After all, the red fox has survived as the commonest and most adaptable of medium-sized predatory animals to the present-day, as has the jackal. However, as said, we did not succeed in proving the presence of the latter among the finds, although as a species adapted to scavenging on the fringes of human settlement, like the hyena, *Hyaena hyaena* (fig. 5.25), of which a total of seven bones were found, it sought food around the settlements of ancient Hesban.

In our preliminary report, we made mention of four fox metacarpi and two phalanges which belong together (C.5:104). Should this skeletal forefoot not be that of a small red fox vixen, then it may possibly belong to a smaller species, the sand fox, *Vulpes ruppelli* (*cf.* also Weiler 1981: table 39). If this latter surmise should prove correct, these bones too must have been imported in the skin. The surroundings of the tell are hardly suitable as a habitat for a desert species such as the sand fox.

Figure 5.24 Mongoose, *Herpestes ichneumon* (after Anderson and Winton 1902: pl. 27).

Figure 5.25 Striped hyena, *Hyaena hyaena* (after Haltenorth and Diller 1977: pl. 38.3).

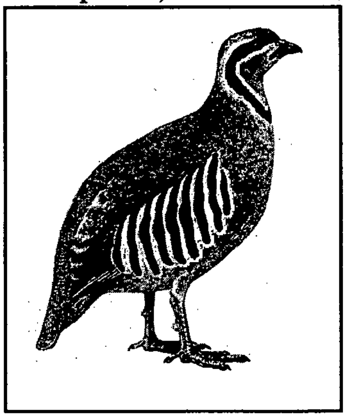


Among the dog bones was the distal end of a remarkably large humerus (A.3:69, Stratum 8), which stands out so clearly from the remainder that we are inclined to regard it as the remain of a wolf, *Canis lupus*. With the greatest breadth of its distal end being 44.2 mm (Weiler 1981: 1985), the bone is smaller than those of the powerful European wolves. It may be assumed, however, that the southern wolves do not reach the size of their northern cousins.

To close this section on wild mammals, it remains only to mention the porcupine, *Hystrix hirsutirostris*, the largest rodent represented in

Plate 5.5 Porcupine, *Hystrix indica* (after Mohr 1965).

Figure 5.26 Chukar partridge, *Alectoris chukar* (after Hüe and Etchécopar 1970: pl. 4.4).

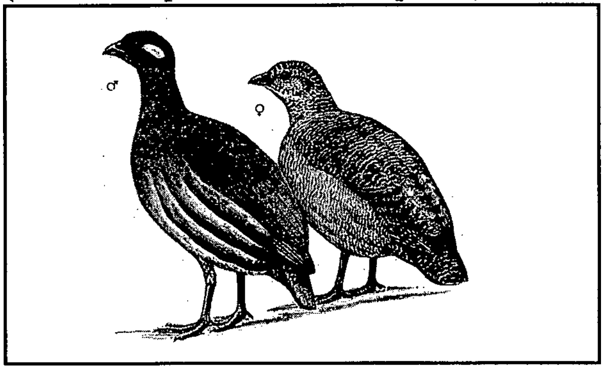


the collected finds (pl. 5.5). A bone belonging to this species, the femur of a juvenile (D.6:33, Stratum 3), was identified among the finds of one of the earlier excavations by Lepiksaar (LaBianca 1973: 134; *cf.* also Weiler 1981: 206). Because of their dangerous spines, porcupines are unlikely to have appealed to the hunters of early history as quarry. They dig tunnels deep into the earth, for the most part on high ground. Thus Tell Hesban, at a time when it was not settled, may have attracted an animal of this species and provided it with a safe abode.

Wild Birds

Like the wild mammal finds, the finds of wild birds (table 5.3) are made up of at least two different components, namely: 1) birds hunted by the inhabitants of the tell; and 2) birds whose presence is due to some natural process. Although this secondary group, to which most of the bones of small birds belong, constitutes only a small proportion of the bird finds, it does warn us of the possibility of disruption in the cultural context, especially when taken in connection with finds of burrowing mammals, and in particular the numerous remains of the mole rat. These natural occurrences are usually to be found among small collections of bones belonging to different species. Thus, for example, Locus F.30:3 (given as Mamluk period, "soil fill in tomb shaft and arcosolia") contained bones of the: wheatear (2), blackbird (1), starling (1), hardoun (2), coluber (2), and variegated toad (4 = 1 individual). One is left with the compelling impression that these are remains of the regurgitated pellets of a little owl or a barn owl. The bones of both are present in the finds (table 5.3, *cf.* also Boessneck, chapter 8).

Figure 5.27 Sand partridge, *Ammoperdix heyi* (after Etchécopar and Hüe 1967: pl. 5.9).



Among the actual game birds, the tasty chukar, *Alectoris chukar* (fig. 5.26), predominates. Of all species of game bird in the area around the tell, it is practically the only one which has maintained its position to the present day. Its characteristic call, "chuken chuken," can still be heard today floating up from the ravines on the western slopes of the tell.

Figure 5.28 Ostrich, *Struthio camelus* (after Hüe and Etchécopar 1970: 21).

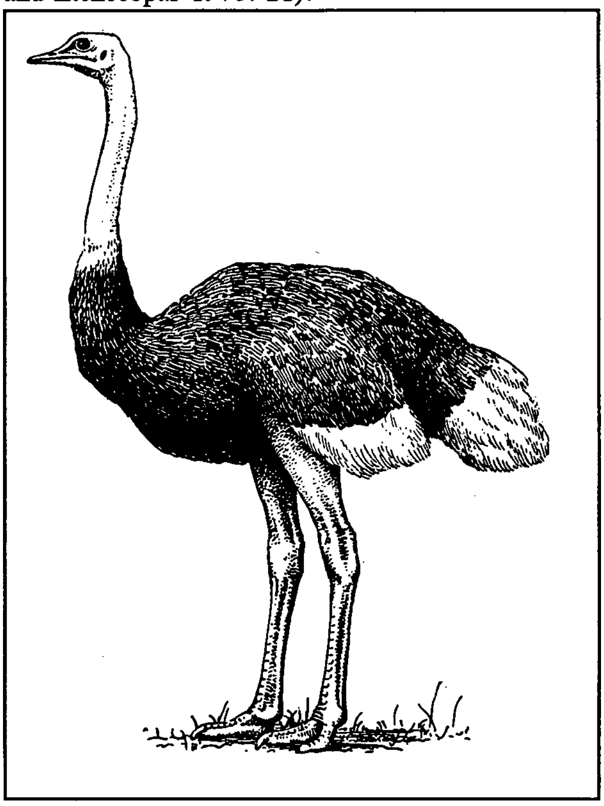
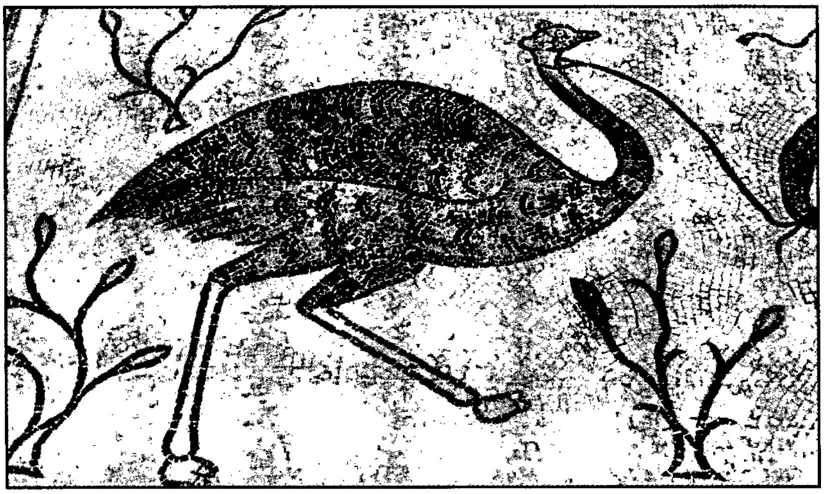


Plate 5.6 Ostrich; detail of the mosaic in the church of Mt. Nebo, Jordan.



among the finds is the Houbara bustard, *Chlamydotis undulata* (fig. 5.30). It too has become a rarity in Jordan over the last few decades. It has had to withdraw deep into the desert in order to survive (Bodenheimer 1935: 172ff.). The flesh of both species of bustard is considered tasty. The marks caused by carving which were found on a femur of the Houbara bustard (Boessneck, chapter 8, fig. 8.20) are evidence that the late inhabitants of Tell Hesban also had a taste for bustard meat.

Closely related to the chukar and represented in the bone finds by a single bone is the far less common sand partridge, *Ammoperdix heyi* (fig. 5.27). It is possible that this bird is still to be found in the steep-sided gorges on the eastern edge of the Jordan Valley, to the west of Tell Hesban (Boessneck, chapter 8).

Of the species represented on the list of wild birds, special mention needs to be made of the ostrich, *Struthio camelus*, which was formerly part of the natural avifauna of Palestine and Syria (Bodenheimer 1935) and died out in the Middle East only in our own century (fig. 5.28). It is frequently portrayed in mosaics in the region (pl. 5.6).

Of the bustards, the presence of the great bustard, *Otis tarda* (fig. 5.29), is remarkable, as far to the south as Moab. Well represented

Figure 5.29 Great bustard, *Otis tarda* (after Hüe and Etchécopar 1970: 253).

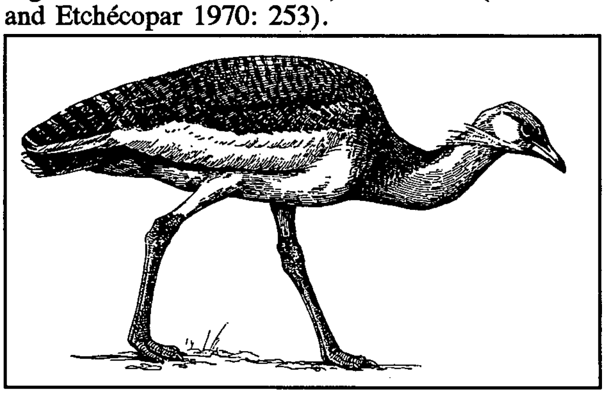
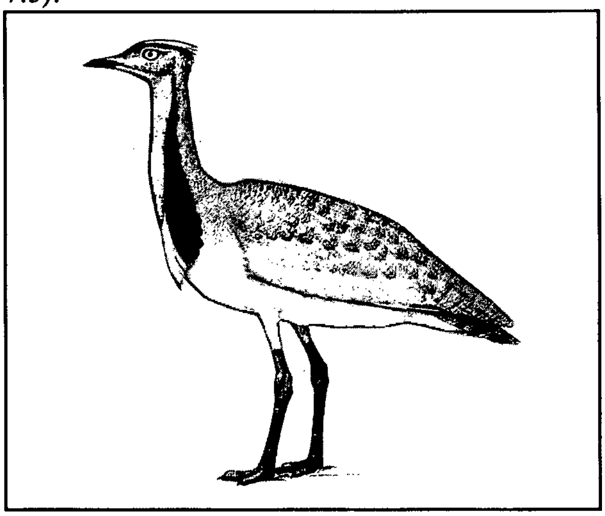


Figure 5.30 Houbara bustard, *Chlamydotis undulata* (after Hüe and Etchécopar 1970: pl. 7.3).



In earlier times, the corncrake, *Crex crex* (fig. 5.31), roamed, in company with the quail, in large numbers throughout Palestine. Today, it occurs only occasionally (Bodenheimer 1935). The majority of the bone finds belonging to this species date from the Roman period. In this, it differs from most of the other species, finds of which, in conformity with the overall pattern of finds, tend to occur in the greatest number during the Mamluk period. Did the Romans prize the corncrake as a particular delicacy?

Of historico-cultural significance is the find already reported (Boessneck and von den Driesch 1978: 281f.) of a large falcon humerus. It is that of a fledgling which had been removed from the eyrie, probably to be trained for hunting. Species of large falcon nesting in the Hesban area (fig. 5.32), to which the find may thus belong are: the Peregrine falcon, *Falco peregrinus*; the Barbary falcon, *Falco pelegrinoides*; and the Lanner falcon, *Falco biarmicus*, the most common of the large falcons of Palestine (Hüe and Etchécopar 1970: 189).

Figure 5.33 Griffon vulture, *Gyps fulvus* (left); Black vulture, *Aegypius monachus* (right); Egyptian vulture, *Neophron percnopterus* (bottom); (after Etchécopar and Hüe 1967: pl. 2).

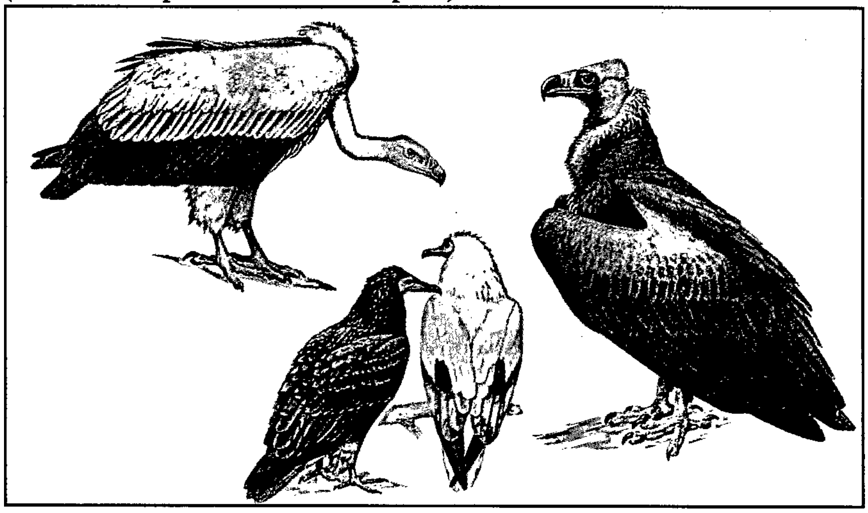
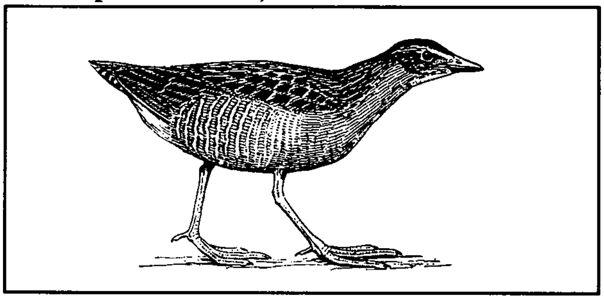
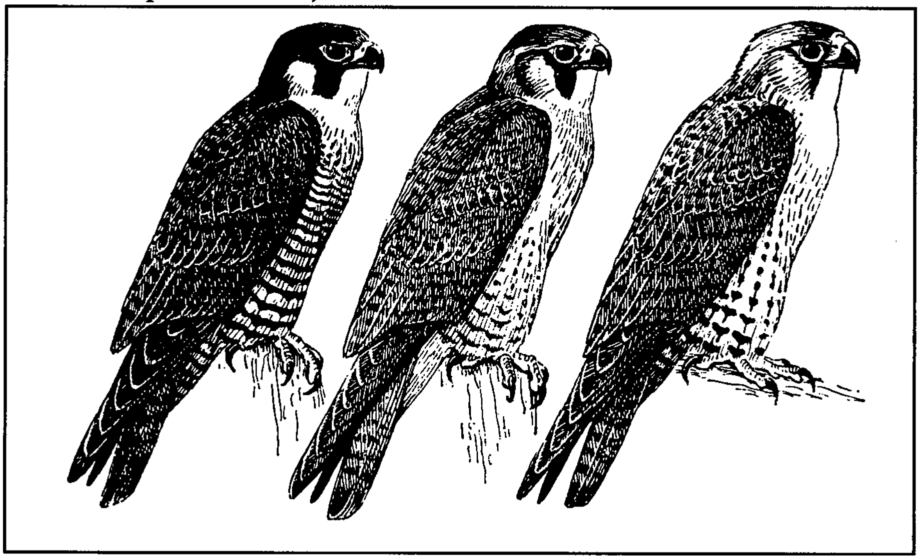


Figure 5.31 Corncrake, *Crex crex* (after Hüe and Etchécopar 1970: 245).



In ancient times, vultures were common in the environs of the tell. There was plenty of refuse and carrion available in the form of kitchen waste and the carcasses of domestic animals. Three species have been identified (fig. 5.33): the huge Black vulture, *Aegypius monachus*; the only slightly smaller griffon vulture, *Gyps fulvus*; and the Egyptian vulture, *Neophron percnopterus*.

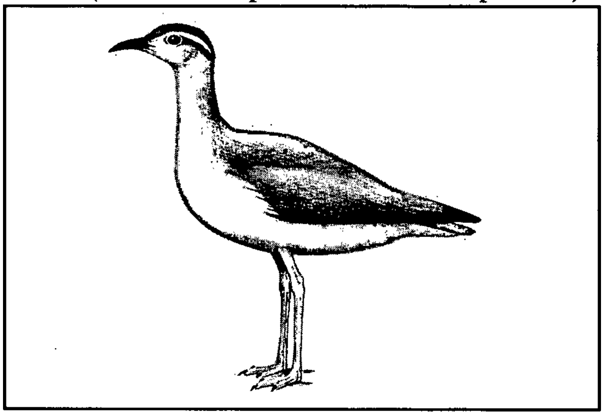
Figure 5.32 Peregrine falcon, *Falco peregrinus* (left); Barbary falcon, *Falco pelegrinoides* (middle); Lanner falcon, *Falco biarmicus* (right); (after Hüe and Etchécopar 1970: 189).



The Black vulture is a rare resident of the Jordan Valley. This huge, solitary bird is said to drop living sheep and goats into precipices, but the writer has not yet been able to verify this statement as far as Palestine is concerned (Bodenheimer 1935: 171).

It would go well beyond the scope of this summary to describe individually every one of the species of birds identified (table 5.3) in the finds. We refer the interested reader instead to the report by Boessneck (chapter 8). As table 5.3 makes clear, the finds of wild

Figure 5.34 Cream-colored courser, *Cursorius cursor* (after Etchécopar and Hüe 1967: pl. 7.10).



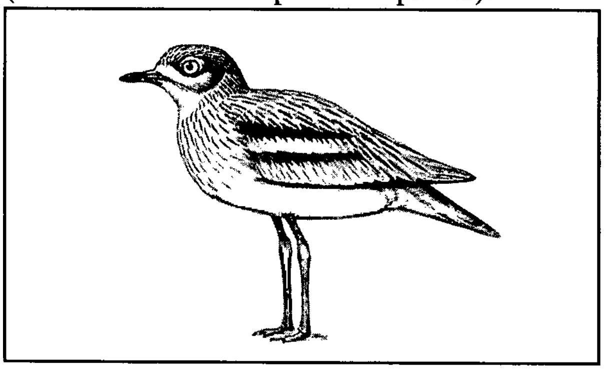
avifauna from Tell Hesban provide primarily evidence of birds whose habitat is dry and stony country, among them both the inhabitants of steep, rocky slopes with vegetation consisting of trees and maquis, and those of valleys with fields and fallow land. Waterfowl (*e.g.*, the coot, *Fulica atra*) are rare exceptions.

It remains only to give an indication of the appearance of two species, present in the prehistoric and early historical bone finds, which are not everyday occurrences: the cream-colored courser, *Cursorius cursor* (fig. 5.34), whose habitat is country bordering on the desert; and the stone curlew, *Burhinus oedicnemus* (fig. 5.35), a nocturnal inhabitant of barren land, steppe, and semidesert (*cf.* also Boessneck, chapter 8, fig. 8.6).

Reptiles and Variegated Toads

The bones of animals belonging to this group

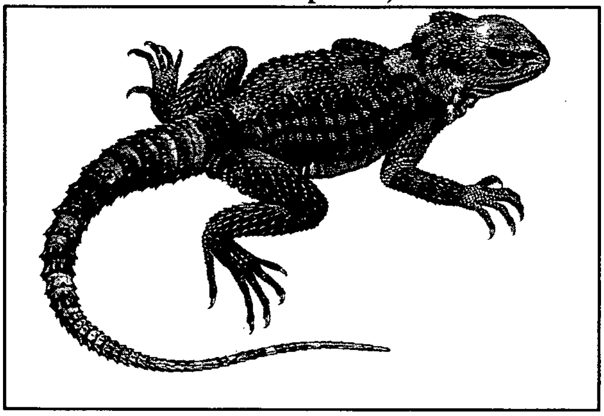
Figure 5.35 Stone curlew, *Burhinus oedicnemus* (after Hüe and Etchécopar 1970: pl. 7.2).



are almost without exception the product of natural thanatocoenosis. What kind of person would be interested in catching snakes or toads to eat? The eating of frogs' legs was not socially acceptable in ancient times (Keller 1913: 313), quite apart from the fact that no frog bones were present in the Tell Hesban finds.

The tell is a natural habitat of the variegated toad and the four species of reptile listed in table 5.4. Locus C.5:161 = 167 (Stratum 3) bears witness to a minor tragedy in the animal world. Here was found the skeleton of a coluber, *Coluber* species, with a length of considerably more than a meter, which, judging from the circumstances of the find, had eaten two young mole rats shortly before its death. Death caught the reptile unawares, for it had not even had time to digest its prey.

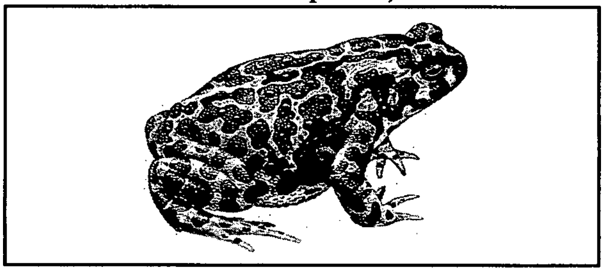
Figure 5.36 Hardoun, *Agama stellio* (after Arnold and Burton 1979: pl. 8.3).



Three of the species belonging to the group dealt with in this chapter are the hardoun, *Agama stellio* (fig. 5.36), the scheltopusik, *Ophisaurus apodus* (pl. 5.7), which is a relative of the generally familiar slow-worm, and the variegated toad, *Bufo viridis* (fig. 5.37).

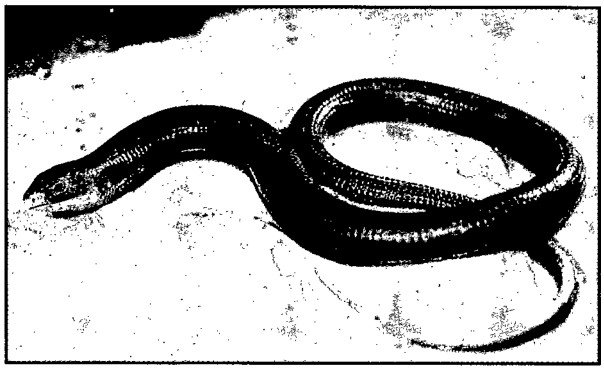
The vast majority of the reptile bones are those of the tortoise, *Testudo graeca*. Bones of this species were found in almost all of the strata. The tortoise is, of course, one of the natural inhabitants of the tell, and many of the partial skeletons point to animals which had dug burrows into the earth and there died (Boessneck, chapter 8). Many of the bones, however, are in such a state of fragmentation that one is compelled to consider the possibility that they are kitchen waste. It is true that, when asked, people emphatically reject the idea of eating tortoise meat. Nevertheless it seems that poor people (herdsmen, perhaps) do eat it from time to time. This at any rate is something we observed in Eastern Turkey (*cf.* Boessneck and von den Driesch 1975: 160).

Figure 5.37 Variegated toad, *Bufo viridis* (after Arnold and Burton 1979: pl. 8.3).



In the case of tortoises, it is not only their use as food which needs to be considered. Their shells are used as bowls and also as the sounding-boards of lutes and lyres (Boessneck, chapter 8). The discovery at C.1:134 (Stratum 18) of the ventral shell of a tortoise, in which holes had been drilled, leads us to assume that these shells were thus used.

Plate 5.7 Scheltopusik, *Ophisaurus apodus* (after Knaurs Tierreich 1957: fig. 51).



Fish

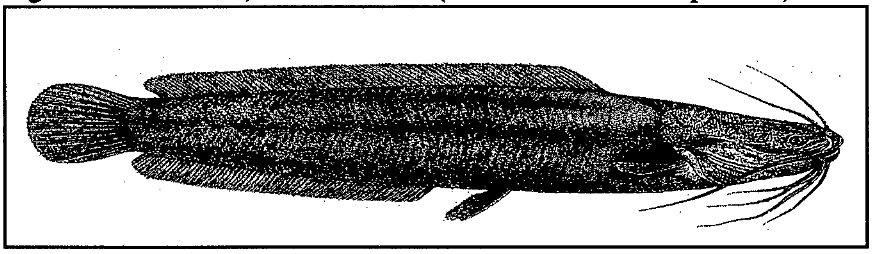
The fish remains include those of both freshwater and sea fish (tables 5.5 and 5.22). Overall, finds of sea fish exceed freshwater ones five or sixfold. They were taken predominantly from the Red Sea (Gulf of Aqaba), but also, especially in the Roman period, from the Mediterranean, of the very beginning of the settlement of the tell (Stratum 18), if the dating of a number of the finds of sea fish to the Iron Age is correct.

There are a total of 920 fish finds (Lepiksaar, chapter 9). Insofar as it has been possible to assign them to species and periods, they are distributed over the individual periods as shown in table 5.22. It is, to begin with, the quantitative distribution of the finds which is of interest. If we draw comparisons with the finds of animal remains taken as a whole, then the Mamluk strata yielded very few fish bones. Units of the Hellenistic/Roman period provided the most fish remains not only in relative terms but also in absolute terms. It was predominantly sea fish, and

Table 5.22 Total count of identified fish bones from each stratum (1968-1976).

	Tell Hesban Strata															
Species	18	17	15	14	13	12	11	10	9	8	6	5	3	2	1	Total
cichlids																
Cichlidae	-	-	-	1	-	-	1	-	-	8	25	-	17	1	1	54
catfish																
Clariidae	-	-	1	1	1	-	-	-	3	5	8	3	21	12	1	56
carps																
Cyprinidae	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	5
grey mullets																
Mugilidae	-	-	-	-	-	-	-	-	-	-	1	-	4	-	-	5
parrotfish																
Scaridae	-	1	-	1	1	-	-	1	2	2	7	1	56	28	-	100
drums/croakers																
Sciaenidae	-	-	-	62	-	-	-	-	-	1	-	-	1	-	-	64
mackerels/tunnies																
Scombridae	-	-	372	4	60	3	16	-	-	1	-	-	-	-	-	456
bass																
Serranidae	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	2
sea bream																
Sparidae	5	-	-	-	-	-	-	-	1	-	-	-	1	-	-	7
Totals	5	2	373	69	62	3	17	1	6	17	42	4	105	41	2	749
Total of Main phases	⊢ 7 ⊣		⊢ 524				⊣	⊢		70		⊣	⊢ 148 ⊣			

Figure 5.38 Catfish, *Clarias lazera* (after Tristram 1884: pl. 19.5).



almost exclusively tunny and meager, which the inhabitants of the tell in this period consumed, whereas most of the freshwater fish identified and the bulk of the remains of parrot fish from the Red Sea were discovered in medieval strata.

The freshwater fish were caught in the Jordan system. The principal catch was *Clarias lazera* (fig. 5.38), a species of predatory catfish with an eel-like body, which can grow to more than a meter in length. Most of the *Clarias* brought to Tell Hesban, however, were only 50-60 cm long (Lepiksaar, chapter 9). In addition, the inhabitants of Tell Hesban ate fish of the Cichlid family (fig. 5.39): *Tilapia galilaea* and/or *Tilapia nilotica*, both of which are good for food. According to Bodenheimer (1935: 428), *Tilapia galilaea* is Palestine's most common freshwater fish, "including the lakes of Hula and Tiberias as also the Jordan system."

Less preference was shown for members of the carp family, as we might assume from the number of finds (table 5.22). Lepiksaar, however, believes that members of this family may be under-represented by comparison with other freshwater fish because their skeletons are more fragile than those of, say, *Clarias* and *Tilapia*. This author repeatedly refers us to the loss due to "scavenging animals," dogs and cats, which have a particular predilection for fish remains. At least two species of whitefish are represented: a species of barbel, and *Varicorhinus*, a slim, barbel-like fish, which is probably *Varicorhinus damascinus* (fig. 5.40), one of the most common whitefish of Palestine (Lepiksaar, chapter 9).

Figure 5.39 Tilapia, *Tilapia nilotica* (after Tristram 1884: pl. 18.1).

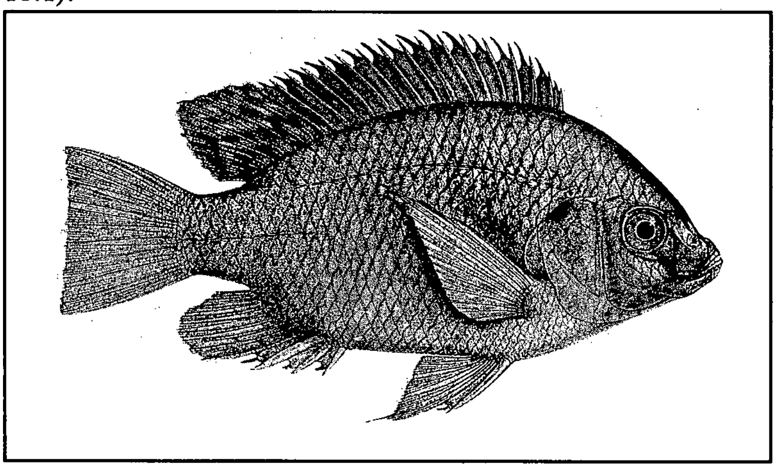
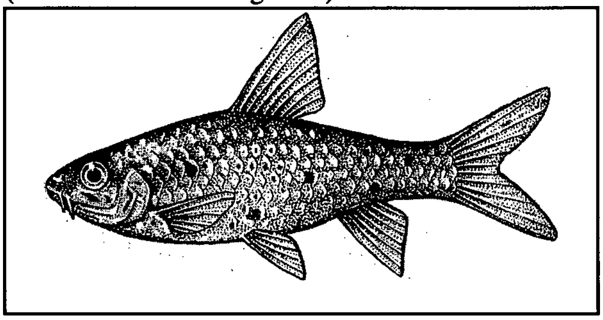
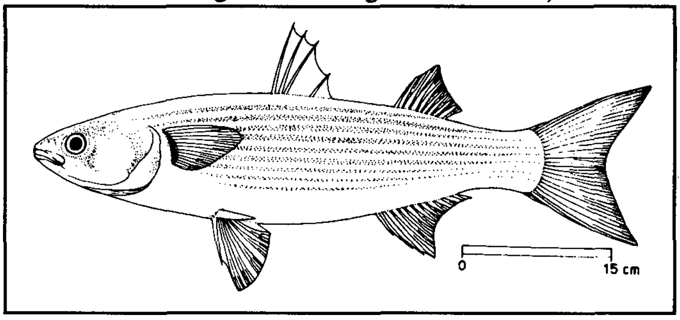


Figure 5.40 Whiting, *Varicorhinus damascinus* (after Sterba 1977: fig. 229).



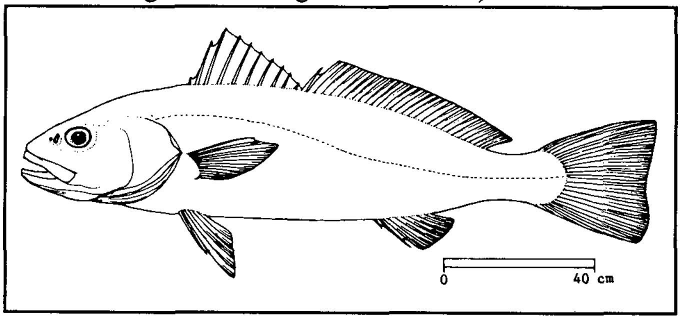
Grey mullet, Mugilidae (fig. 5.41), are, properly speaking, marine fish which enter the brackish water of river estuaries. However, they also penetrate a considerable distance upstream. They were imported to Tell Hesban. Several species belonging to this family occur both in the Mediterranean and the Red Sea. Individual examples are anatomically very similar, and it was, thus, not possible to determine with a sufficient degree of certainty from which sea the fish found at Tell Hesban were taken. In view of the great importance which these fish have had since classical times for fishery in the Mediterranean, it seems likely that grey mullet were taken to the site from the western sea coast (Lepiksaar, chapter 9).

Figure 5.41 Thinlip grey mullet, *Mugil capito* (after U.N. Food and Agriculture Organization 1971).



Also of Mediterranean origin is the wreckfish or stone bass, *Polyprion americanum* (fig. 5.42), an Atlanto-Mediterranean species belonging to the family Serranidae, the sea bass. This family owes both its Latin and German (Zackenbarsche) names to the striking, saw-like form of the dorsal fin. The wreckfish is a warmwater species. Older specimens, which can reach a length of up to two meters, are solitary and live on rocky areas of the seabed. For this reason they are not caught with nets but "with baited hook or by underwater spearing" (Lepiksaar). A number of other serranid finds among the collection differ in their morphology from bones of the wreckfish. They resemble those of the genus *Epinephelus* (grouper), several species of which occur both in the Mediterranean and in the Red Sea. As good food, groupers may have been imported occasionally from the sea coasts. Probably, like the stone bass, they come from the Mediterranean side, where according to Bodenheimer (1935: 462ff.) a number of species belonging to this genus are caught (Lepiksaar, chapter 9).

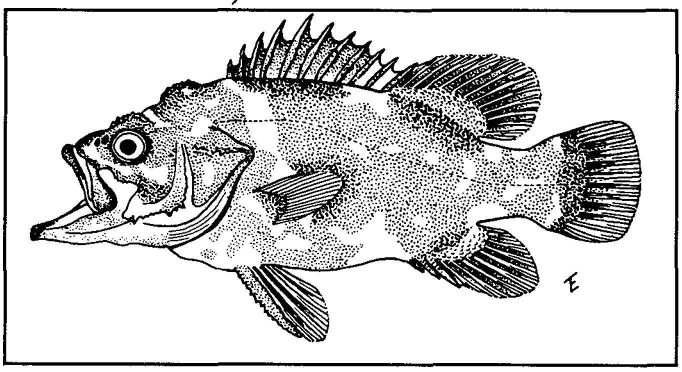
Figure 5.43 Meager, *Johnius hololepidotus* (after U.N. Food and Agriculture Organization 1971).



Sixty-two of the 67 bone finds which have been identified with reasonable certainty as belonging to the meager, *Johnius hololepidotus* (fig. 5.43), were found in Stratum 14. This very good food fish also originates from the Mediterranean. According to Bodenheimer (1935: 464), "the meagre is one of the most common market fish. It is always present, but shows a decided maximum from December to March." Those meager found at Tell Hesban (at least three individuals altogether) had overall lengths of 30 cm, 50 cm, and 90-100 cm, respectively.

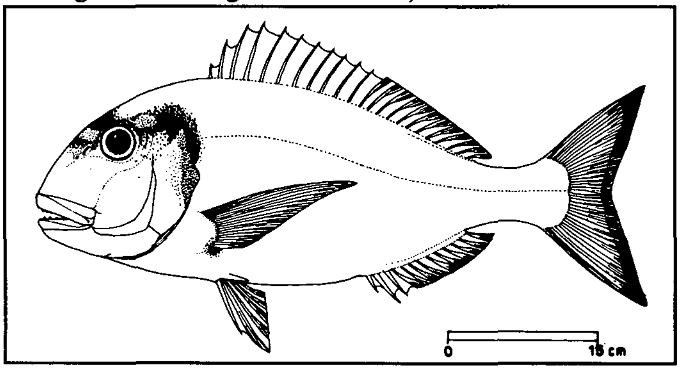
There were difficulties in assigning the jawbones of sea bream (Sparidae) to particular species. According to Lepiksaar, there is a very good degree of correspondence between the finds

Figure 5.42 Stone bass, *Polyprion americanum* (after Tortonese 1975: 61).



and bones of the gilthead bream, *Sparus auratus* (fig. 5.44), a Mediterranean species. This is something which we are able to confirm, the finds having been sent to us in Munich to be photographed. However, Lepiksaar asks us to bear in mind that there are closely related species living in the Red Sea for which neither he nor we have skeletons available for comparison. Five of the eleven finds are dated as belonging to the Iron Age alone. However, there is much to be said in favor of their having been imported from the Mediterranean coast. This fish has been of great importance and value for fishery in the Mediterranean since antiquity (*cf.* also Keller 1913: 369f.).

Figure 5.44 Gilthead, *Sparus auratus* (after U.N. Food and Agriculture Organization 1971).



The majority of fish finds, around 500, are bones of the family Scombridae, relatives of the mackerel, or rather of the tunny (table 5.22; Lepiksaar, chapter 9). At least three can be assigned to the frigate mackerel or plain bonito, *Auxis thazard*, a small tunnyfish with striking markings (fig. 5.45), which has a cosmopolitan range in the subtropical oceans.

The majority of the bones of fish of the Scombrid family, however, belong to one or another species of tunny (at least 30-40 individual fish). Lepiksaar identified these as probably being *Katsuwonus pelamis* (the true bonito, or Skipjack) and *Euthynnus affinis*, using a process of elimination, because he had no skeletons of present-day examples of these available for comparison. On the strength of this, when we received the finds in Munich, we compared them with bones of *Katsuwonus pelamis* from the collection of skeletons which we keep for purposes of comparison. The identification of most of the remains as belonging to *Katsuwonus* is plainly correct. We are unable to offer an opinion as to whether *Euthynnus affinis*, which osteologically must be very similar to *Katsuwonus*, is also present. *Katsuwonus*, a medium-sized tunny (fig. 5.46), has the same range as *Auxis thazard*, but does not occur in the eastern Mediterranean, according to information published by the FAO (1971), and, thus, off the coast of Palestine. On the other hand, huge catches of this species are apparently made in the Gulf of Aqaba (Steinitz and Ben-Tuva 1955: 9). It is, therefore, highly likely that all of the tunny found at Tell Hesban were transported from there.

Figure 5.45 Frigate mackerel, *Auxis thazard* (after U.N. Food and Agriculture Organization 1971).

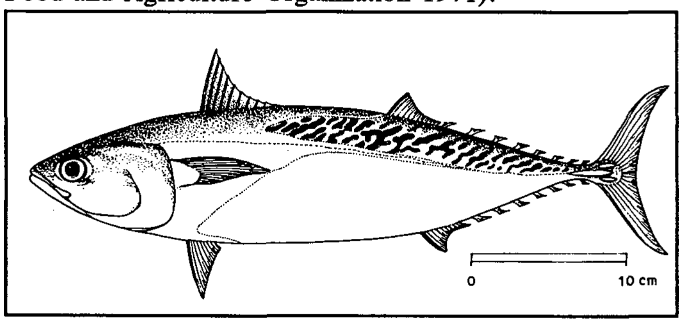


Figure 5.46 Oceanic bonito (Skipjack tuna), *Katsuwonus pelamis* (after U.N. Food and Agriculture Organization 1971).

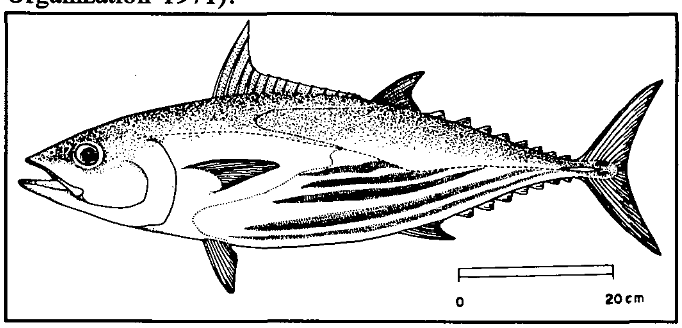
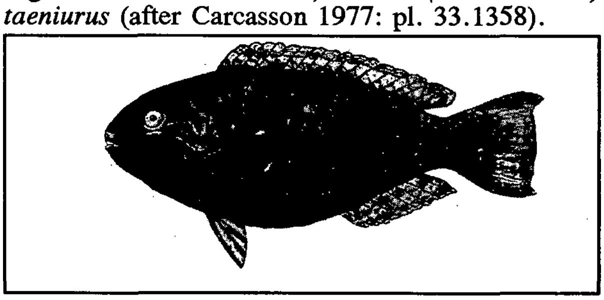


Figure 5.47 Parrot fish, *Scarus (Pseudoscarus) taeniurus* (after Carcasson 1977: pl. 33.1358).



In this connection it is interesting to note that the finds of *Katsuwonus*, and *Euthynnus*, consist almost exclusively of bones of the head, among them some really well preserved neurocrania. Since the few vertebrae all come from the forward part of the body, it really looks as if only the heads of these fish were imported. The finds are concentrated in two areas, D.2:80 (Store Silo

80) and D.2:95b (Store Silo 95), Stratum 13. These findings are all the more remarkable, because under normal circumstances the delicate, fragile head bones of tunny were rarely so well preserved.

Lepiksaar comments in chapter 9 that

> in contrast to the finds of other fish groups—except the small Sciaenids—the osseous substance of the Scombrid finds is remarkably porous and brittle. It seems to have lost a great deal of its organic matter. Usually the bones of tunnies are very fatty and may therefore be destroyed in a relatively short period by their own fat acids.
>
> Such taphonomical autolysis has obviously not been the case with the Scombrid remains from Tell Hesban. As already mentioned, while they have not been decalcinated, they have lost their binding organic component. One reason why they may not have gotten rancid is because they were treated with salt to preserve them under their long distance transport from the Red Sea to Tell Hesban. Then, after being eaten, the fatty acids were absorbed by the soil from their discarded remains without affecting the bone substance.
>
> Another remarkable peculiarity of the Scombrid finds is that there is a lot of neurocranial parts preserved. These usually are very rare as scavenging animals normally devour them right away as they are full of fat and contain brain remains. This, too, is an indication that the Scombrids brought to Hesban were salted and thus made untasty for the scavengers.

In conversation with the archaeologists carrying out the excavation, we learned (see also Herr 1978: 115ff.), that at D.2:80 and D.2:95b, beside this large quantity of fish remains, there had lain a sizable collection of broken, Early Roman, storage vessels. Thus the question of how the Scombrids survived the long journey from the Gulf of Aqaba to Tell Hesban is explained. They were taken there in storage jars as garum. D.2:80 and D.2:95b were garum stores of Roman Hesban. This fish sauce, used principally for seasoning food, was highly prized by the Romans. Garum was produced in massive quantities, and in many places on the Mediterranean coast mass-production techniques were used. It was principally the worthless parts of large fish (their heads and innards) and very small fish which were used (for more, see von den Driesch 1980). This fashionable trend in culinary taste also, it seems, penetrated as far as Tell Hesban.

By contrast, the parrot fish of the family Scaridae, which also come from the Red Sea, must have been smoked when taken to Tell Hesban. One does not salt such valuable, tasty food fish, whose flesh has been praised by gourmets as far back as classical antiquity (Lepiksaar, chapter 9; Keller 1913: 340).

The occurrence of members of the family Scaridae is confined to the tropical seas. One species, the parrot fish, *Sparisoma cretense*, lives in the Mediterranean, principally in the eastern part. According to Lepiksaar, however, the bulk of the Scarid finds are of *Pseudoscarus* (fig. 5.47). Parrot fish, which all have very striking and colorful markings, live on algae, which they strip from coral reefs using their characteristic "parrot's beak" formed by the upper and lower jaws. The broken-off pieces of coral are crushed by the tooth-bearing pharyngeal bones. Digestible matter is absorbed and indigestible particles are egested. Of the fish families represented in the Tell Hesban finds, the Scaridae occupy second place in terms of frequency of occurrence (table 5.22). However, the loss of bone is greater than in the case of the Scombrids, which enjoyed circumstances particularly favorable to their preservation. If we take as the basis for our comparison the minimum number of individuals (MNI = 30 to 40), we find that parrot fish and tunny are, from an economic point of view, of equal rank.

Conclusions

The extensive finds of animal bones from the excavations on Tell Hesban provide us with detailed insight into the role of animals in the economy of the human settlements on the tell. This role was based almost exclusively on the keeping of domestic animals: small ruminants, cattle, pigs, horses, asses, mules and hinnies, camels, dogs, cats, and chickens. Shifts over the four main phases in the percentages of the various species represented in the finds (table 5.10) reflect: a) changes in the environment; and b) socio-ethnic changes. Thus the increase in the keeping of goats (fig. 5.3) in the Ayyubid/Mamluk period probably indicates a deterioration in grazing conditions. This assumption is supported by the fact that cattle in the Middle Ages were, apart from a few exceptions, smaller in stature than in the preceding periods (figs. 5.5, 5.6, and 5.7). Socio-ethnic changes, or for that matter, changes in religious practice are reflected in the increase in pig-keeping during the Byzantine settlement phase and its decline into almost total insignificance in the Mamluk period, or, for example, in the greater importance of the dromedary in the period when the tell was settled by the Arabs. In the High Middle Ages, the keeping of chickens reached a level of importance almost twice that which it enjoyed during the Roman period and the early Middle Ages, a development which cannot be put down to environmental changes.

Even though the role played by hunting in the economy was a minor one, the wild fauna is, as a result of the large quantity of material found, extraordinarily well represented. As far as the larger animals are concerned, this representation is complete (tables 5.2-5.4). The range of species provides us with a picture of the landscape in the area surrounding the tell as it was at the time of the prehistoric and early historical settlements. We can imagine it largely as it appears today, with rather more vegetation in the form of bushes and trees. The wadis in particular must have been richer in vegetation than of present.

Despite the fact that the land in the area surrounding the tell was subject to intensive agricultural use from the very beginning, the native wild fauna was able to maintain its position right up to the recent past, as a comparison of the list of fauna presented here with those of Tristram (1884) and Bodenheimer (1935) shows. The total extermination of the native big game animals and the complete denudation of the countryside are the products of the last few decades of our own century (*e.g.*, Mountfort 1964: 231).

On the evidence of some of the wild animal bones, we were able to demonstrate that skins and hides were imported. This was the case with the maral, the wild goat, and possibly also the wild sheep, among others. This also gives rise to the possibility that the meat requirements of the village and urban settlements on the tell were met, not only from their own herds but also by purchases from neighboring areas. This is especially to be expected of times when the tell was densely settled, although osteological proof would not be possible. Cattle provided the majority of meat for consumption, although in numerical terms the small ruminants were predominant among domestic animals. Horse, ass, and camel meat were evidently eaten, but not, however, that of dogs and cats.

The fish finds provide evidence of a lively trade with the sea coasts (both the Mediterranean and the Gulf of Aqaba). The high proportion of sea fish among the finds of the Hellenistic/Roman settlement phase can be attributed to the fact that during this period a fish sauce, garum, was used at Tell Hesban.

In addition to the remains of the domestic and game animals, there were among the finds numerous bones of natural inhabitants of the tell whose presence in the material is not in any way due to man and his activities. Examples are the bones of the mole rat, snakes, and toads. Although archaeologically of no significance, such finds have their own contribution to make to the reconstruction of the history of the hill, if only because they are a natural and integral part of the whole picture.

Notes

[1] This manuscript, and those of chapters 6-9, were submitted to the publisher in 1981. There has been no possibility to revise the original manuscripts at a later stage.

[2] In the meantime, the following work has been edited on this topic: Corinna Steiger, "Vergleichend morphologische Untersuchungen an Einzelknochen des postkranialen Skeletts der Altweltkamele," unpublished dissertation, Munich, 1990.

[3] Davis (1977: 154) identified a horn core of *Capra aegagrus* from En Gev I on the Sea of Galilee (15-16,000 B.C. transition from the Palaeolithic to the Natufian period). Clutton-Brock (1979: 151), on the basis of identification by Uerpmann, believes remains of the wild goat to be present in Protoneolithic material from Jericho. However, the cited dimensions of two humeri and one radius match those of domestic goats from Tell Hesban.

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Chapter Six

EVIDENCE OF DEER IN THE EARLY HISTORICAL PERIOD OF TELL HESBAN, JORDAN

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Chapter Six

Evidence of Deer in the Early Historical Period of Tell Hesban, Jordan[1]

Introduction

The Jordan Valley and its contiguous valleys which reach deep into the mountains bordering the great rift valley are included in the former range of the red deer (*Cervus elaphus* Linné, 1758), and the Mesopotamian fallow deer (*Cervus [Dama] mesopotamicus* Brooke, 1875; according to Haltenorth 1959: 42. The latter is known generally in osteoarchaeological literature as *Dama mesopotamica* Brooke, 1875).

Pre-historic Findings

Dama mesopotamica has been present in faunal remains since the Acheulian; *Cervus elaphus* from the Mousterian to the Natufian (Mesolithic; Vaufrey 1931: 256f.; Vaufrey 1951: 201f., 211; Bate 1932, 1937, 1942; Angress 1960; Ducos 1968; Legge 1973; Davis 1974). The fallow deer was at times the predominant ungulate in the area (Bate 1937: 141, 210; Legge 1973: 91; Fritsch 1893; Hooijer 1961), while the red deer was less numerous. From the relative numbers of fallow deer and gazelles, conclusions can be drawn about climatic changes that have occurred:

> In view of the fact that Deer are typical inhabitants of forest and jungle country, while Gazelles are equally typical desert dwellers, it seems legitimate to suggest that the transition from Deer to Gazelles as the dominant species, indicates a change from moist conditions in Mousterian times to a dry climate in the Mesolithic, with a consequent alteration from a wooded to a more open country. That such a modification of climate must have been gradual is suggested by the overwhelming preponderance of Deer in the Mousterian, followed by the appearance of Gazelles and Deer in equal proportions in the Aurignacian, succeeded in turn by the very numerous Gazelles in the Mesolithic. ...
>
> In this connection it is important to remember that these environmental preferences are reflected in the anatomy of these animals. Deer have low-crowned petaloid cheek teeth suitable for browsing on deciduous leaves and other soft herbage, and hooves adapted for soft ground. The cheek teeth of Gazelles are, on the other hand, narrower, higher crowned and more goat-like, fit to cope with coarse herbage and scrubby growth, while their slender cannon bones and small and close, hard feet are fitted for rapid progress on hard ground (Bate 1932: 278; Bate 1937: 142).

After the Mesolithic, remains of the red deer are practically nonexistent. Only Mesopotamian fallow deer are found.

Historic Findings

Examples from Palestine

The recent archaeological evidence from Palestine includes an antler and humerus from the Early Bronze Age in Tel-Gat (Ducos 1968: 111f.), a "small antler fragment" from the Early Bronze Age in Arad (Davis 1976: 163), and three pieces of antler from an Iron Age level from Lachish, not far from Tel-Gat (Lernau 1975). These last cannot be positively identified, but "probably belong to a Fallow deer, in which case it would be *Dama mesopotamica*" (Lernau 1975: 90). The fallow deer has become extinct in Palestine only within the last century (Bodenheimer 1935: 114; Bodenheimer 1958: 178). Tristram (1884: 4) had seen it, but considered it to be *Dama dama* (*cf.* Harrison 1968: 368).

The disappearance of the two species, however, was not due to climatic change. Humans are to blame for their extinction in the Jordan area. The destruction of their habitat was accomplished by the deforestation of slopes and cultivation of valleys, leaving the deer no range. Hunting wiped out the remaining few. The Jordan Valley and its surrounding area were soon so densely populated by humans that the possibility of survival for the remaining few deer disappeared. That the Mesopotamian fallow deer stock in the vicinity of Hesban in Jordan survived the Iron Age—and that perhaps also isolated red deer could be found as late as the Middle Ages—is suggested by these finds.

Table 6.1 Measurements[1] of the bones of *Dama mesopotamica* from Tell Hesban, in comparison with finds of *Dama dama* from Demirçihüyük in northwest Anatolia (according to measurement procedures in von den Driesch 1976).

Bone			Tell Hesban							Demirçihüyük				
a) Scapula														
SLC	33.0	29.5[2]	-	27.0	-[2]				27.5	24.5[2]	24.0			
GLP	-	52.0	53.0	-	46.5				-	42.5	-			
LG	-	41.0	39.0	-	35.0				-	34.5	-			
BG	(39.0)	(37.0)	36.0	36.0	31.0				-	31.5	28.5			
Gender	♂	♂	♂	?	♀				♂	?	♀			
b) Humerus														
Dp			64.5											
c) Humerus														
Bd			44.5[3]			45.5	-	-	(41.5)	(40.0)	39.5	39.5	38.5[3]	38.0
BT			41.5			42.5	(40.0)	39.5	37.5	-	37.0	36.5	36.5	34.5
Gender			♀?			♂	♂	♂	♂	♂	?	?	♀	♀
d) Radius														
Bp	(52.0)[4]	50.0	48.0[4]	44.5[4]			43.5[4]	42.5	42.3	42.0	41.0	37.5[4]		
BFp	46.0	46.0	44.0	41.0			40.0	40.5	39.0	38.0	38.0	34.5		
Gender	♂	♂	♂	♀			♂	♂	♂	♂	♂	♀		
e) Metacarpus														
Bd			33.7[5]					31.7[5]	31.0	29.0	28.0			
Gender			?					♂	♂	♀	♀			
f) Acetabulum														
LA			50.0							43.0				
Gender			♂							♂				
g) Femur														
Bd			55.0											
h) Tibia														
Bd			42.5[6]				38.0	37.5[6]	36.7	35.5	35.0	34.0		
Gender			♂				♂	♂	♂?	?	♀	♀		
i) Astragalus														
GLl			(47.0)[7]				40.5[7]	(39.0)	39.5	-	39.0	35.0		
GLm			45.0				37.5	(37.0)	36.5	-	-	34.0		
Dl			-				24.0	-	22.0	-	22.0	20.0		
Bd			-				27.3	(25.0)	24.5	25.0	-	21.5		
Gender			♂				♂	♂	♂	?	char-coal	♀		
k) Metatarsus														
Bd			40.0[8]							30.0				
Gender			♂							♀?				
l) Phalanx														
GLpe			45.0[9]				47.0	46.5[9]	46.0	45.0	45.0	44.7	49.0	
Bp			16.8				16.5	16.3	16.0	16.0	15.5	15.5	18.0	
SD			12.5				12.5	12.0	12.3	11.5	12.0	11.0	12.0	
Bd			15.0				15.0	14.7	14.3	14.0	14.0	14.0	15.0	
fore/hind			fore				fore	fore	fore	fore	fore	-	hind	
Gender			♀				♂	♂	♂	♂	♂	♂	♂	

									Demirçihüyük					
Phalanx 1														
GLpe		(49.0)	48.5	(48.0)	47.5	47.0	47.0	42.0[9]	41.0	39.0[9]	45.5	45.0	45.0	41.7
Bp		(16.0)	17.0	-	16.5	17.0	17.0	14.7	14.5	14.7	15.5	16.0	16.0	15.0
SD		11.0	11.0	11.0	11.5	11.5	11.3	11.0	10.0	10.2	10.5	10.5	10.5	9.7
Bd		(14.5)	15.0	13.5	14.5	14.7	14.7	13.7	13.0	13.0	13.0	14.0	13.5	12.5
fore/hind		hind	hind	hind	hind	hind	hind	fore	fore	fore	hind	hind	hind	hind
Gender		♂	♂	♂	♂	♂	♂	♀	♀	♀	♀	♀	♀	♀
							Dama mesopotamica, recent male							
Phalanx 1														
GLpe							49.5	49.0	52.0	51.0				
Dp							18.0	17.8	19.0	18.5				
SD							13.5	13.6	13.5	13.7				
Bd							16.0	16.0	17.0	17.0				
fore/hind							fore	fore	hind	hind				
inner/outer							inner	outer	inner	outer				

[1] SLC = smallest length of Collum scapulae; GLP = greatest length of Processus articularis; LG = length of glenoid cavity; BG = breadth of glenoid cavity; Dp = depth of the proximal end; Bd = greatest breadth of distal end; BT = breadth of the trochlea; Bp = greatest breadth of proximal end; BFp = greatest breadth of the Facies articularis proximalis; LA = length of the acetabulum, including the lip; GLl = greatest length of lateral part; GLm = greatest length of the medial half; Dl = greatest depth of the lateral half; Glpe = greatest length of the peripheral half; SD = smallest breadth of diaphysis.
[2] *cf.* pl. 3; [3] *cf.* pl. 2; [4] *cf.* pl. 5; [5] *cf.* pl. 8; [6] *cf.* pl. 6; [7] *cf.* pl. 5b,c; [8] *cf.* pl. 7b; [9] *cf.* pl. 9;

Deer Bones at Tell Hesban

Deer bones make up only a small part of the over 100,000 bone pieces found at Tell Hesban during five seasons of excavation, many fewer than gazelle bones. Most of the finds come from domestic animals, predominantly sheep and goats.

Tell Hesban was inhabited from *ca.* 1200 B.C. to A.D. 1500 (Boraas and Geraty 1976). Although most of the fallow deer bones—and all of those measurable (table 6.1)—came from the time period 700-500 B.C. (Iron Age II/Persian; Areas B1 and B2: secondary fill material from a large water reservoir), the majority of the other animal bones came from the Ayyubid/Mamluk period (12th to 15th centuries A.D.). The local fallow deer population may already have been extinct by this time.

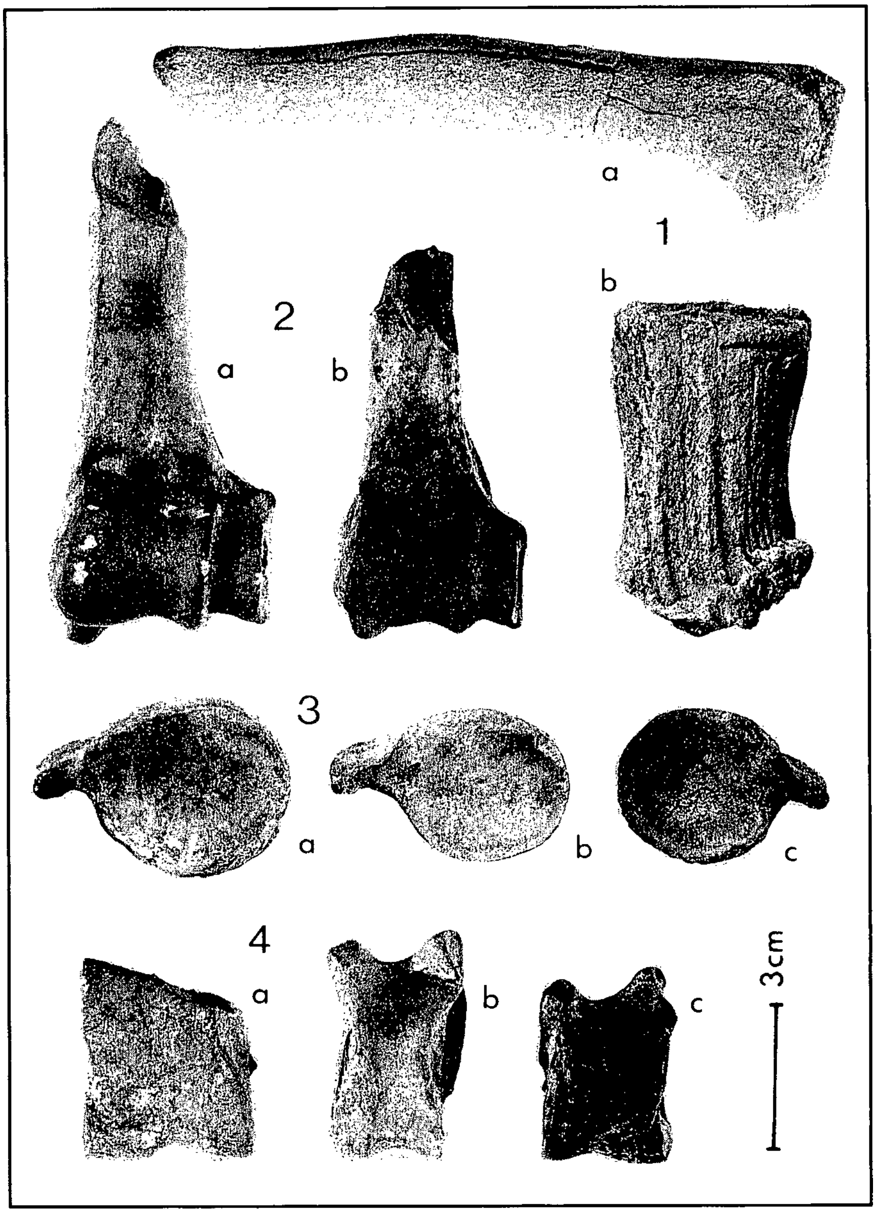
Species Comparison from Tell Hesban

The classification of "Mesopotamian fallow deer" for the bones from Tell Hesban is based primarily on bone size and only secondarily on the geographical distribution of *Dama dama* and *Dama mesopotamica* (Haltenorth 1959). The Mesopotamian fallow deer is larger than the so-called "European" fallow deer. The male fallow deer bones from Tell Hesban are among the largest measured.

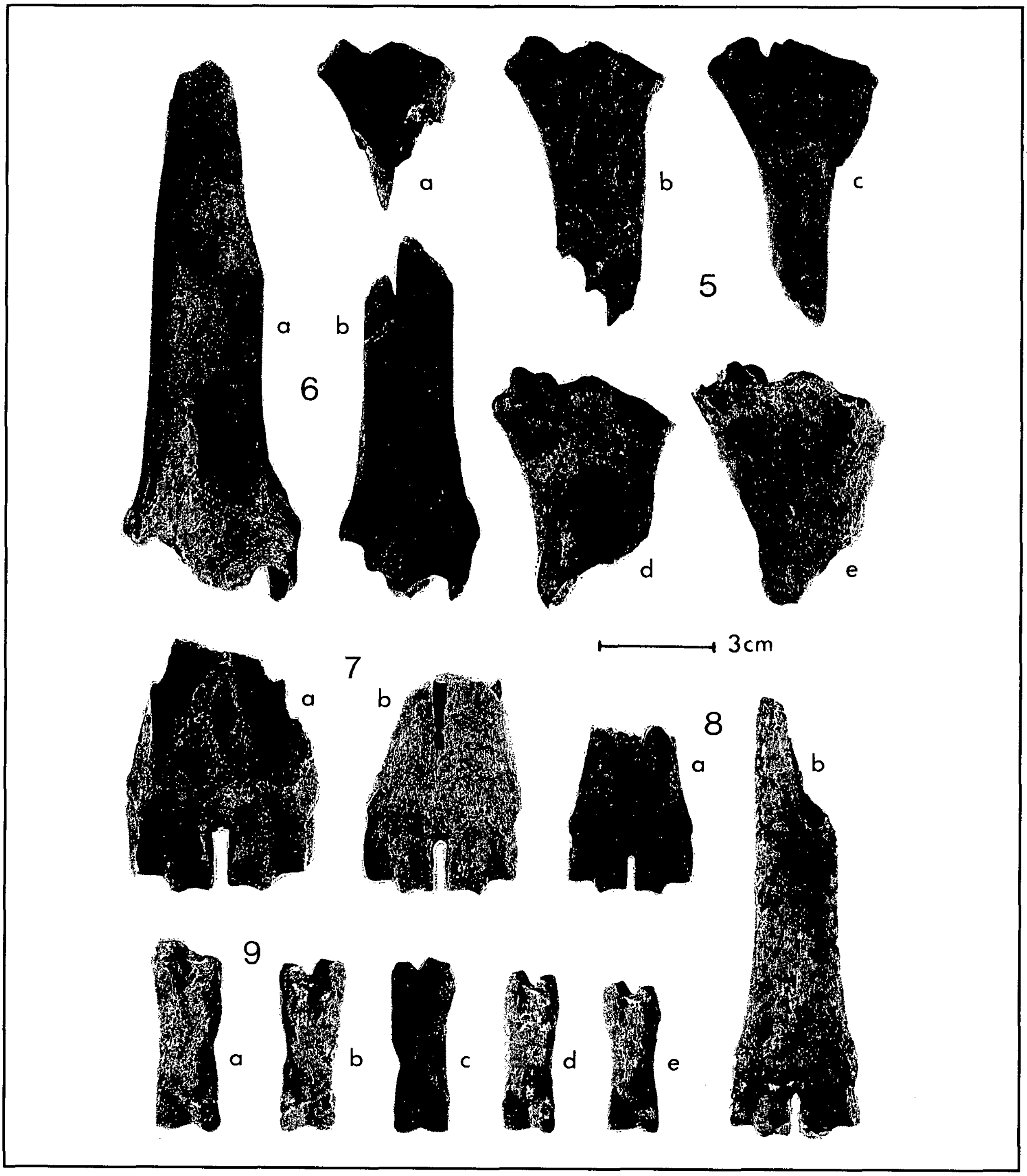
Ducos (1968: 162f.) published a series of comparable measurements for Mesopotamian fallow deer from Ain-Mallaha and Cyprus (1965: table 1). The two largest proximal radius ends, a distal third of a tibia, and the distal end of a metatarsus, all from Hesban (table 6.1d,h,k; pls. 6.5d,e, 6.6a, and 6.7b), are extremely large compared to this previous series.

We are presenting the measurements of the Tell Hesban finds singly so that they may be able to

Plates 6.1-6.4 **1) Antler**, chopped; Hesban, *D. mesopotamica*. **2) Humerus**, distal end, cranial view; (a) Hesban, *D. mesopotamica*, (b) Demirçihüyük, *D. dama*; Bd 44.5 and 38.5 mm. **3) Scapula socket**, distal view; Hesban, *D. mesopotamica* (a) ♂ and (b) ♀; (c) Demirçihüyük, *D. dama*; LG 41.35 and 34.5 mm. **4) Tali**, plantar view; (a) Hesban, *Cervus elaphus* (Bd = 37) and (b) *D. mesopotamica* ♂ (GLm = 45; laterally broken); (c) Demirçihüyük, *D. dama* ♂ (Bd = 27.3, GLm = 37.5).



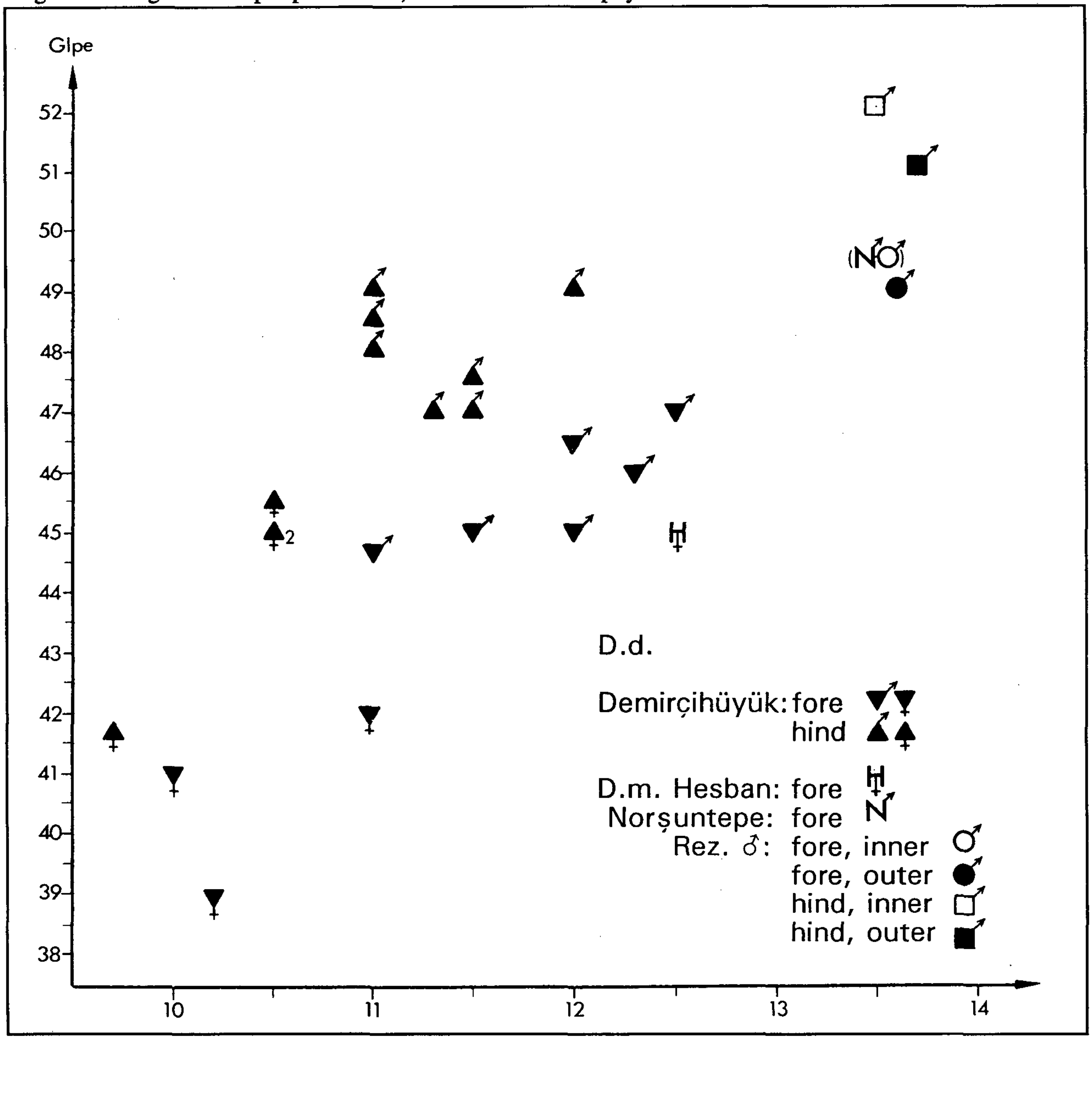
Plates 6.5-6.9 **5) Radius**, proximal end, dorsal view; Demirçihüyük, *D. dama* (a) ♀ and (b) ♂; Hesban, *D. mesopotamica* (c) ♀, (d) ♂, and (e) ♂; Bp 37.5, 43.5, 44.5, 48, and 52 mm. **6) Tibia**, distal end, dorsal view; (a) Hesban, *D. mesopotamica* ♂; (b) Demirçihüyük, *D. dama* ♂; Bd 42.5 and 37.5 mm. **7) Metatarsus**, distal end, dorsal view; (a) Hesban, *C. elaphus* ♂ and (b) *D. mesopotamica* ♂; Bd 49 and 40 mm. **8) Metacarpus**, distal end, dorsal view; (a) Demirçihüyük, *D. dama*; (b) Hesban, *D. Mesopotamica*; Bd 31.7 and 33.7 mm. **9) Phalanges I** from forelegs; (a) Norşuntepe, *D. mesopotamica* ♂; (b) Hesban, *D. mesopot.* ♀; Demirçihüyük, *D. dama* (c) ♂, (d) ♀, and (e) ♀; GLpe 49.5, 45, 46.5, 42, and 39 mm.



point to a probable gender affiliation. A previously unpublished series of *Dama dama* bones (mainly Early Bronze) from Demirçihüyük, *ca.* 25 km northwest of Eskişehir in northwest Turkey, is presented for comparison. Bökönyi (1971) measured *Dama dama* bones of similar size from Neolithic to Early Bronze Age levels at Sitagroi in eastern Macedonia. A size comparison between prehistoric *Dama dama* bones and the *Dama mesopotamica* finds from Tell Hesban can be made. The male *Dama dama* bones are the same size as female *Dama mesopotamica* bones (pl. 6.4). The size difference is smaller when compared with the series of *Dama mesopotamica* measured by Ducos (1968).

The distribution of the fore and hind proximal phalanges of fallow deer from Demirçihüyük are shown in fig. 6.1, as well as the classification of the sole proximal phalanx from Hesban and a find from Norşuntepe in eastern Anatolia. It is not

Figure 6.1 Comparison of phalanges proximals from *D. mesopotamica* (*D.m*) and *D. dama* (*D.d*); GLpe = greatest length of the peripheral half; SD = smallest diaphysis width.



difficult to distinguish a front phalanx from a rear (Bosold 1966: 12; Besold 1968: 99, and figs. 22-24). The proximoaxial tuberositas on the rear side of the first phalanx reaches half the length of the bone on the front leg, and only 2/5 the length on the rear leg.

Gender determination is possible by first separating the finds into fore and hind, and then separating each of these into two size groups. The proximal phalanx separation in Ducos's measurement tables into "antérieure" and "postérieure" without any overlapping in the length is at least curious because there is indeed a clear difference in size between male and female *Dama* (Duco 1965: 8; Duco 1968: 163; see also Fritsch 1893: 16). This sexual dimorphism is also expressed in the length of the phalanx (Bosold 1966; 1968: table 3, and diagram V). The only proximal phalanx from Hesban, a foreleg phalanx (pl. 6.9b) is from a female—based on its size.

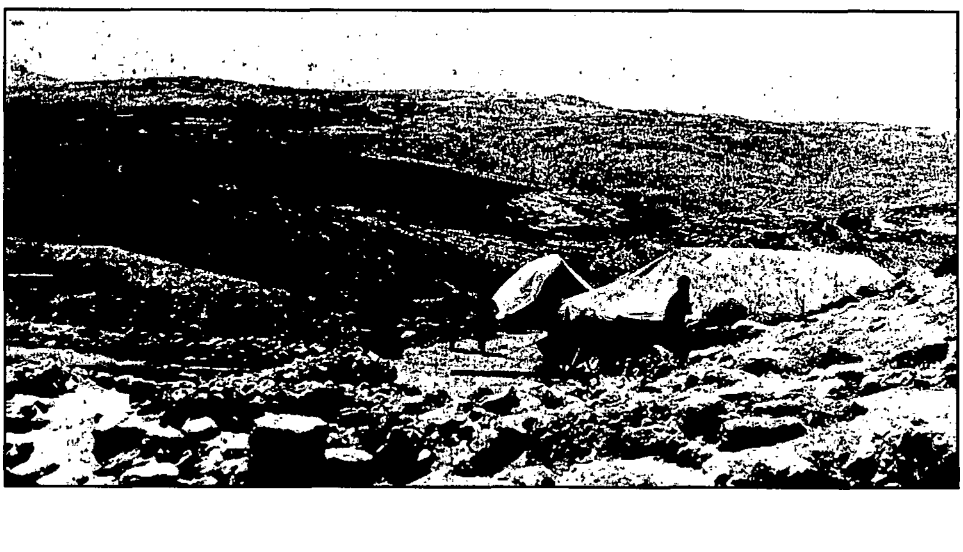
The front proximal phalanx among the finds from Norşuntepe (pl. 6.9a), a site in Altinova, southeast of Elâziğ in eastern Anatolia is remarkable. Out of all the bones found in Altinova with completed identification, this proximal phalanx and a metatarsal splinter are the only evidence for the occasional presence of fallow deer in this area. At first we thought that species could not be determined with only a single specimen (Boessneck and von den Driesch 1976: 95). Based on the series from Demirçihüyük, however, it was identified as *Dama mesopotamica*. The phalanx is too large to be *Dama dama*. By comparing it with the Tell Hesban finds, it could only have come from a male. This identification was confirmed by measuring the first phalanges of a 2 year, 7 month old male Mesopotamian fallow deer from Arabistan (fig. 6.1 and table 6.1), the skeleton of which is preserved in the Bavarian State Zoological Collection (1957/250; Haltenorth 1959: 22ff.). In Norşuntepe, we have the northern-most evidence of a Mesopotamian fallow deer.

From the singular size of some fallow deer bones, one might suspect that we were actually dealing with remains from *Cervus elaphus*, especially since there were very few bones to evidence its presence. Incontestible proof of the red deer is presented by the distal half of a talus (pl. 6.4a) with the greatest distal width (greatest width of Caput) of 37 mm, and the distal end of a strikingly large metatarsus (pl. 6.7a) with Bd of 49 mm. Such widths are reached in the maral deer (known for its large size) only in the stately males (*cf.* Vogel 1952: 130; Ducos 1968: 158). Both bones were recovered from sites containing material from the Ayyubid/Mamluk period, the last era in which Tell Hesban itself was occupied. Since finds from older periods are lacking, one could speculate that it belonged to an old loner which had wandered through the valleys before being killed in the Tell Hesban area. Or could we have an imported fur piece before us?

Schmid (1969: 105, and fig. 5) reports the custom of skinning goats, so "that the horns and the lower parts of the feet remained attached to the skin." Such is indicated in our specimen by the fact that the talus is cut through transversely (pl. 6.4a)—a difficult and rare undertaking—and that only a single distal half is present, just as only a single distal end is present from the metatarsus.

The size of this red deer bone alone helps remove any suspicion of false identification. There is, however, a partial size overlap between larger

Plate 6.10 View from Tell Hesban toward the southwest.



Dama mesopotamia bones and those from smaller specimens of female marals. Therefore, morphologically, there are good differentiating characteristics which allow positive identification if the pieces are not too small and inconspicuous. Concerning the metapodia and phalanges, reference should be made to Schmid (1965) and Bosold (1966, 1968). The sturdy fallow deer metatarsus is characteristically flattened on the dorsal side above the epiphyseal suture. The trochea are relatively small (pl. 6.7b). On the radius, the tuberositas radii is more distal than in *Cervus elaphus*. The lateral tuberositas is more devel-oped—unrelated to the marked bony ridge on one of the finds. The lateral facet of the proximal joint surface does not appear so narrow as in red deer. On the other hand, the medial lip of the Tell Hes-ban find is not drawn out so "sheeplike," as is often found on *Dama dama* radii (Bökönyi 1971: fig. 3).

The few, poorly preserved remains of antlers bring no further information. Two of the best preserved pieces are shown in pl. 6.1. They are cut off and the base of the antler is burnt inside.

The Ancient Hesban Habitat

When one has seen the bare hills around Tell Hesban, with its acropolis 895 m above sea level, one must wonder where the deer found range to graze in the days of ancient Hesban (pl. 6.10). The wide depression in the direction of Madaba was certainly the choicest farmland of the tell's inhabitants. The narrow, deeply cut wadi falling away westward did not offer enough freedom of movement, even if it was covered with thick vegetation in ancient times.

An ideal area, however, must have been the Ain Hesban Valley, less than two hours by foot northwest of Tell Hesban. Here, abundant springs flow all year, allowing high, dense vegetation. The hollow downstream from the springs was swampy and inaccessible. Deer and wild boar found cover here. From here they could set out to browse along the Wadi Hesban above the springs and the slopes, which at that time still had stands of oak and pistachio (Feinbrun and Zohary 1955: map 6; Zohary 1962: map 5). This original landscape met the needs of the Mesopotamian fallow deer (Haltenorth 1961) until it was destroyed by clearing and cultivation.

Note

[1] From the Institute for Paleoanatomy, Domestication Research and History of Veterinary Medicine of the University of Munich. Translated by Stephen Tobin from: Hirschnachweise aus frühgeschichtlicher Zeit von Hesbon, Jordanien. *Säugetierkundliche Mitteilungen* 25 (1977): 48-57.

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Chapter Seven

BONES OF THE WEASEL, *MUSTELA NIVALIS* LINNÉ, 1766, FROM TELL HESBAN, JORDAN

Joachim Boessneck†

Chapter Seven

Bones of the Weasel, *Mustela nivalis* Linné, 1766, from Tell Hesban, Jordan[1]

Introduction

Among the more than 100,000 animal bones recovered during the five seasons of excavation at Tell Hesban was a series of weasel bones. Tristram (1884: 22) is the only source that mentions weasels in Palestine, placing them in the area of Mt. Tabor. Two weasels from Lebanon were described by Harrison and Lewis (1964; also Harrison 1968: 235ff.).

Tell Hesban lies in the mountains on the eastern side of the Jordan Valley, reaching an elevation of 895 m above sea level. The excavations at Tell Hesban recovered artifacts dating from the early Iron Age to the Mamluk period (*ca.* 1150 B.C. to A.D. 1456), covering 10 to 12 cultural periods (Boraas and Geraty 1976). When the site was founded, typical Mediterranean tree and bush vegetation covered the area (Zohary 1962: chart 5). Since the Tell Hesban weasel bone corpus is the earliest evidence for this species in Jordan, this publication should arouse considerable interest. (The analysis of other animal-bone finds is given by Boessneck and von den Driesch in chapter 5.)

Analysis of the Weasel Bones

Material

The finds from Tell Hesban contain the remains of 8-10 weasels. A humerus (locus C.1:133), from which the loose proximal epiphysis had fallen off, and an adult pelvis (locus C.1:134) are dated to early Iron Age (*ca.* 1200-900 B.C.). Most of the finds come from loci dated to the Early Roman period (*ca.* 63 B.C. to A.D. 130).

An adult skull (locus B.4:232; pls. 7.1a and 7.2a) seems to belong together with a humerus (pl. 7.3b) from the same locus. Parts of a skeleton from a young animal were found at locus B.4:258. The distal epiphysis was fused to the humerus and the proximal was loose (pl. 7.3a); the radius showed just the reverse. The femur, tibia, and fibula all have open epiphysis fusion lines proximal and distal. All of the permanent teeth have appeared on the lower jaw, though it had not reached its full length. A roof of a cranium from locus B.4:259 could have come from this skeleton, or a slightly older animal. The facial bones are missing, the frontomaxillary suture being open.

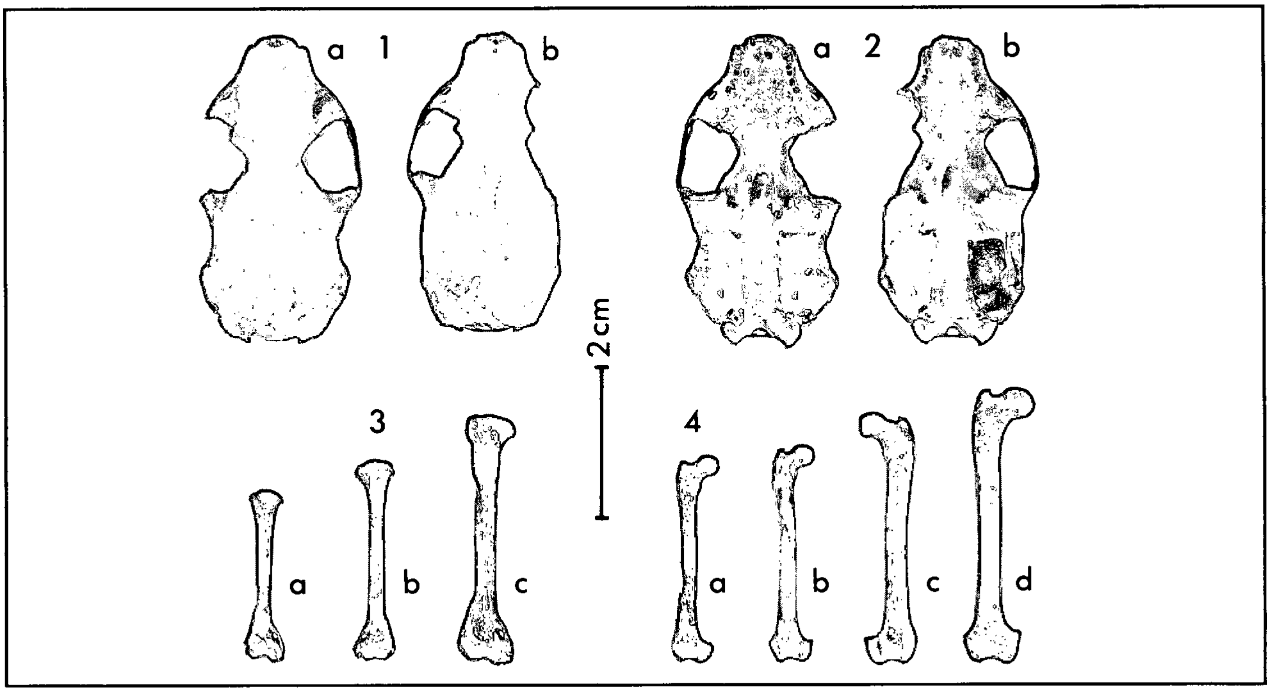
A nearly complete skull with the left half of the lower jaw, also from B.4:259 (pls. 7.1b and 7.2b), belongs to an immature weasel. In this cranium, the nasomaxillary suture was in the process of uniting; the frontomaxillary suture still appears as a fine line. Ribs and long bones from the immature and from an adult skeleton were also found at the same site.

The most valuable finds are the two crania, which allow all important measurements to be made, except the cheekbone width (table 7.1a). In choosing dimensions to be measured, see the documentation of subfossilized weasel finds from Anatolia (Boessneck 1974). Some of the dimensions have been defined by Reichstein (1957: fig. 1) and Harrison (1968: table 124; Harrison and Lewis 1964: table 2) and should also be considered. (The erroneously given dimensions c-m^3 and c-m_3 are corrected in Harrison (1968): C-M^1 and C-M_2).

Dating

A pair of femurs (pl. 7.4b), a tibia belonging to the femur, a lumbar vertebra (D.2:95c-e), and a radius (B.4:228) were dated to Early Roman times. From the Early Byzantine period came fragments of an adult cranium with the right half of the mandible (Cw.7:49). Also found with the Byzantine finds (*ca.* A.D. 365-661) were a femur (locus B.7:14) with its proximal end broken off and

Plates 7.1-7.4 **1) Dorsal** and **2) basal** views of weasel crania: (a) B.4:232, (b) B.4:259 (subadult). **3) Humeri**; (a) B.4:258; (b) B.4:232; (c) D.4:138. **4) Femora**; (a) A.4:28; (b) D.2:95c; (c) D.1:60; (d) B.4:243.



a tibia (locus A.6:59). The femur (locus A.4:28; pl. 7.4a), excavated in 1971 and previously reported by LaBianca (1973: 134, 139), is not dated.

Although cultural periods are given according to the associated archaeological finds, I must question whether in this case this dating can be justified. Weasels and other small mammals lived on the hill, predominantly at times when there were no human inhabitants. Therefore, it is difficult to determine if the remains stem from natural deaths or are culturally related, since weasels search the passages made by mole rats and other subterranean dwellers.

Sex Features

Both Reichstein (1957: 161ff.) and the review of the finds from Anatolia (Boessneck 1974: 310ff.) discussed in detail the secondary gender characteristics on the skull. To all appearances, the skulls found in Tell Hesban all belonged to males and are of uniform size. The ridges where the temporal muscles originate are not as marked as on the male skulls from Anatolia (*cf.* pl. 7.1 with Boessneck 1974: fig. 1a-d), but that can be explained on the one hand by the smaller size of the Jordanian skulls, and on the other hand by the youthful age of two of the skulls. A clear mark of a male is the relief on the adult skull from locus B.4:232 (pl. 7.1a). In both subadult skulls, the crista sagittalis begins as far in front as in the adult skull, but the linea nuchalis superior is not yet so markedly drawn out, nor is the brow so strongly bound (pl. 7.1b). On the remains of the dorsal cranium from the fourth skull, the crista sagittalis is split far in front, but less marked. The deep postorbital binding marks it as an adult, which is confirmed by the teeth (Boessneck 1974: 310).

The skull measurements offer the only possibility of comparing the two weasels from Lebanon with the finds from Tell Hesban. The smaller of the two is allegedly a male. The gender of the slightly larger one is not known. Both are smaller than the male weasels from Tell Hesban. In the picture of the weasel skull from Kammouha, which has been gender identified, the ridges for the origin of the temporal muscle are hardly noticeable. If it were not known to have come from a male, the skull could easily be considered to that of

Table 7.1 Measurements of weasel bones from Tell Hesban as well as three bones of the marbled Polecat (*V.p.*) for comparison.

Bone	Loci					
a) Skull ♂ (*cf.* pls. 7.1 and 7.2)		B.4:232	B.4:259[1]	B.4:259	Cw.7:49[2]	
Basal length (Basion-Prosthion)		39.0	38.5	-	-	
Basilar length (Reichstein 1957)		37.7	37.0	-	-	
Condylobasal length (Reichstein 1957)		42.0	41.3	-	-	
Greastest width over Condyli occipitales		11.0	11.6	-	-	
Mastoid width (Reichstein 1957)		20.6	(20.0)	-	-	
Brow, narrowest point		7.2	8.9	8.3	7.1	
Frontal breadth		11.8	11.1	10.4	10.9	
Interorbital width (Reichstein 1957)		9.6	8.7	8.8	8.9	
Width across the canini (alveoli)		9.0	8.8	-	-	
Length of teeth row (Reichstein 1957)		13.5	12.8	-	-	
Length of M^1—back row to C-Alveoli—front row		12.0	11.3	-	11.2	
Remarks:		-	subadult	juvenile-subadult	-	
b) Lower jaw ♂			B.4:258	B.4:259[1]	Cw.7:49[2]	
Total length: back row of Condylus (lateral) to Infradentale			-	21.8	-	
Length: Condylus—back row to C-Alveoli—back row			-	19.2	-	
Length: M_2—back row to Infradentale			13.3	13.8	(13.5)	
Length: M_2—back row to C-Alveoli—back row			10.0	11.0	(10.5)	
Length: M_2—back row to C-Alveoli—front row			12.7	13.0	-	
M_1—Length			4.3	4.2	4.4	
M_1—Width			1.7	1.7	1.8	
Ramus mandibulae—Height			-	9.9	9.8	
Remarks:			juvenile-subadult	subadult		
c) Humerus (*cf.* pl. 7.3)		B.4:232	B.4:258	C.1:133	D.4:138	
Greatest length		27.1	-	-	33.6	
Greatest length without proximal epiphyse		-	23.2	23.1	-	
Greatest width proximal		5.6	-	-	6.8	
Smallest width of diaphysis		2.2	2.2	2.0	3.0	
Greatest width distal		5.9	5.9	5.3	7.9	
Remarks:		♂	♂ juvenile-subadult	juvenile-subadult	*V.p.*	
d) Radius		B.4:228				
Greatest length		17.9				
e) Pelvis		C.1:134				
Greatest length, one half		28.3				
Remarks:		♂				
f) Femur (*cf.* pl. 7.4)	A.4:28	B.7:14	D.2:95c[3]	D.2:95e[3]	B.4:243	D.1:60
Greatest length	28.3	(≈30.5)	29.5	29.5	37.0	34.0
Smallest width of diaphysis	2.5	2.7	2.5	2.5	3.5	3.2
Greatest width distal	5.8	6.0	6.0	6.0	8.0	7.3
Remarks:	-	♂	♂	♂	*V.p.*	*V.p.*
g) Tibia		A.6:59	B.4:259[4]	B.4:259	D.2:95d[3]	
Greatest length		29.3	29.9	29.5[5]	31.2	
Greatest width proximal		5.5	6.0	-	6.0	
Smallest width of diaphysis		1.8	2.0	2.0	1.7	
Greatest width distal		3.8	4.2	4.1	4.2	
Remarks:				♂ subadult	♂	
h) Fibula			B.4:259[4]			
Greatest length			27.7			

[1,1,2,2,3,3,3,4] belong together.

[5] without proximal epiphysis

a female, based on the impression from the photo.

The difference in size between the weasels from Tell Hesban and Lebanon might be interpreted as an expression of gender dimorphism. Perhaps the weakly-developed muscle relief is due to the smaller skull size. In smaller skulls, the secondary gender characteristics are less marked since the brain—and thus the brain capsule—in small skulls are relatively large. Consequently the temporal muscles have a larger surface attachment right from the start.

The gender of two of the lower weasel jaws from Tell Hesban was already determined from the skulls to which they belong. The third, the youngest, had not yet changed all its teeth. It also could only have come from a male (table 7.1b). This immature jaw, with its associated humerus, together with the humerus from locus B.4:232, made gender determination possible on the long bones. Most of them are also from males (table 7.1c-h).

Differentiating Weasels

Weasels and Polecats

While it is readily possible, with the help of Harrison's pictures and descriptions (1968: 232f.), to differentiate the skulls of *Mustela nivalis* from *Vormela peregusna syriaca*, the bones from the post-cranial skeleton can be a problem. Marbled polecats from Palestine are small (Harrison 1968: 231ff.) and there is no information available as to the size of the long bones. I have no recent comparative material for the smaller *Vormela peregusna syriaca* subspecies, but based on the skeletons from larger marbled polecats, the long bones seem to be of a more compact build than in weasels. These observations confirm finds from Tell Hesban, which, from their size, can come only from marbled polecats, since we know the size of weasels in this area. The bones in question are more compactly built and cannot be mistaken, even when they are not available in their full length. The measurements of the fully preserved bones are included in table 7.1c,f. For their orientation see also pls. 7.3 and 7.4.

Weasel Sub-species

In size, the Jordan weasel matches the southern European subspecies *Mustela nivalis boccamela* (Reichstein 1957: 154, 177f.). Tristram (1884: 22) classified the Palestinian weasels accordingly under this name. Harrison and Lewis (1964: 180f.; Harrison 1968: 239) took a wait-and-see attitude. Since a large weasel subspecies is found in Asia Minor and the Aegean, between the southern European *Mustela nivalis boccamela* and the similarly sized weasel from Palestine, the designation "boccamel" cannot simply be made.

Weasels and their Prey

Mole rats (*Spalax leucodon ehrenbergi*), house rats (*Rattus rattus*), and Tristram's desert rats (*Meriones tristrami*) may be considered the most important prey for the Tell Hesban weasels. The mole rat has been shown to be present in larger numbers among the finds (Boessneck and von den Driesch 1981). Ziesel (*Citellus citellus*), a possible prey, though not found at Tell Hesban, are still numerous in the stony desert along the road from Amman to Qatrana, where we saw them sitting by their burrows as we drove through one morning in August 1976. Kumerloeve's reservations (1975: 194) about Tristram's statement (1884: 15), "exceedingly abundant on the sandy and stony plains of the uplands of Moab," are thus groundless.

Note

[1] Institute for Paleoanatomy, Domestication Research, and History of Veterinary Medicine, University of Munich. Translated by Stephen Tobin from: Funde vom Mauswiesel, Mushkela nivalis Linné, 1766, auf dem Tell Hesbon, Jordanien. *Säugetierkundliche Mitteilungen* 25 (1977), 44-48.

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Chapter Eight

BIRDS, REPTILES, AND AMPHIBIANS

Joachim Boessneck†

Chapter Eight

Birds, Reptiles, and Amphibians

Introduction

In the rolling hills east of the Jordan Valley and 10 km north of Madaba lies the site of Tell Hesban, which was first settled in the 13th century B.C. Due to the efforts of Ø. LaBianca, five archaeological campaigns between 1968 and 1976 (*cf.* Boraas and Horn 1969, 1973, 1975; Boraas and Geraty 1976, 1978; Geraty 1974, 1977) witnessed a careful sampling of the faunal remains. After some preliminary work on part of these remains (1973, 1975; LaBianca and LaBianca 1976), Ø. LaBianca invited A. von den Driesch and J. Boessneck to participate in the identification of the bone finds. Their preliminary report (Boessneck and von den Driesch 1978, 1980) describes the identification process, reviews the first results, and also presents an almost complete list of fauna. Following these efforts, H. Lindner (1979) made a further analysis of the chicken bones for his dissertation on the early history of the domestic chicken in the Near East. An extended mammalian data analysis has been done by D. Weiler for a doctoral dissertation (1981). Furthermore, LaBianca has been continuing ethnoarchaeological and ecological research focusing on animal husbandry and exploitation in both ancient and present-day Hesban (*e.g.*, 1978a, 1978b). However, there remained to be completed a detailed zoological discussion of the bird, reptile, and amphibian finds. Such is the intent of this report.

From Tell Hesban's summit, some 895 m above sea level, one can see (especially after the harvest) a sparsely repetitive, stony, hilly land. Though the Hesban area—phytogeographically speaking—can be classified essentially as "Mediterranean," it is difficult to imagine today, that in the past, the rocky hill slopes (as well as the wadis) carried a lush maquis vegetation with stands of oaks and pistachios at the more favorable spots (Feinbrun and Zohary 1955: maps 5 and 6; Zohary 1962: map 5; Zohary 1973: fig. 22; Bender 1968: 12). Despite an annual precipitation of only about 300 mm, rainfall is sufficient to support the plant life previously described. The rainy season occurs primarily between the months of November and April and can adequately support rain-fed agriculture as well.

Forest and bush of both the hills and depressions were never able to reestablish themselves following the deforestation which stemmed from the desire for greater agricultural access to the fertile soil. Even when the fields were abandoned, and despite times of possibly higher rainfall, the pasturing of herds assured an end of tree regrowth. Initially, the pasturing of goats on the slopes and the utilization of trees for firewood were not deleterious, especially on the western side, which descends sharply toward Wadi el-Majarr (Boraas and Geraty 1978: fig. 1). The destructive deforestation has occurred only within the 20th century.

> The process of denudation was gradual up to the outbreak of the First World War. It was then greatly aggravated by the Turkish army, which stripped Jordan almost bare of trees in order to fuel the locomotives of the Hejaz railway (Mountfort 1964: 231).

We expect the fauna represented by the Tell Hesban finds to be species that lived primarily in dry, stony places. These animals preferred either rock-strewn slopes with trees and underbrush, or wide depressions with fields and fallow. With regard to poultry, we would expect to find primarily chicken and pigeon.

The bones under discussion were not analyzed separately for each individual campaign because only the 1976 finds were suited for mathematical-statistical treatment (*cf.* Boessneck and von den Driesch 1978: 261; Boessneck and von den Driesch 1981: 56). Furthermore, the bones of the birds, reptiles, and amphibians constitute only a very small portion of the total finds when compared with those of domestic mammal bone finds. Both the text and table 8.8 show which species are frequently represented. Thus it is unnecessary to proceed mathematically. Only a few bones were found for each species in many cases.

Bone-find sites, as well as find datings proposed by the archaeologists, are given whenever they are discussed in detail or presented in measurement tables. Find-site designations, such as H71A.6:18, refer to Heshbon Expedition Campaign 1971, Area A, Square 6, Locus 18. The campaign year is omitted from some tables. Similar to the case of some bone remains from small mammals living on the tell (*cf.* Boessneck and von den Driesch 1978: 262f.; Boessneck and von den Driesch 1981: 56, and in this volume), the bones of some species discussed here might be from a stratum other than that in which they were found.

With the exception of bones which were recovered out of context, the finds are from 1250 B.C.-A.D. 1450. The majority of these finds result from the last occupational phase on the tell, the Ayyubid-Mamluk period (*ca.* A.D. 1200-1456). As previously indicated, bone datings are based on associated archaeological material, especially as they relate to ceramic evidence. However, as seen by the occasional dating changes made since the preliminary report, definitive bone datings are difficult.

The major periods are: Iron Age (IA), 1200 B.C.-sixth century B.C.; Hellenistic-Roman period (HR), 198 B.C.-A.D. 365; Byzantine-Abbasid period (BA), A.D. 365-969; and Ayyubid-Mamluk period (AM), A.D. 1250-1456 (*cf.* Boraas and Geraty 1978: 15ff.; LaBianca 1990). Space limitations prohibit listing the numerical dates in some measurement tables. (See table 5.6 for a list of Tell Hesban cultural divisions.)

Bone measurements are given in millimeters (mm) unless otherwise stated. Measurement abbreviations (table 8.1) are in accordance with the system established by A. von den Driesch (1976). Certain excavation reports have previously given species identification and bone occurrence rates which do not rely on our identifications; however, their data is incomplete and absolutely irrelevant.

Table 8.1 Measurement abbreviations.

Abbreviation		Definition
Bd	=	greatest breadth of the distal end
Bf	=	breadth of the Facies articularis basalis
Bp	=	greatest breadth of the proximial end
CB	=	cranial breadth
CBL	=	condylobasal length
Dd	=	depth of the distal end
Did	=	diagonal of the distal end
Dip	=	diagonal of the proximial end
dL	=	dorsal length
Dp	=	depth of the proximial end
GB	=	greatest breadth
GH	=	greatest height in the medial plane
GL	=	greatest length
L	=	length of the metacarpus II from articular surface to articular surface without the Processus distalis
La	=	axial length
Ll	=	length of the lateral part
Lm	=	medial length
LM	=	length from the Manubrium sterni to the caudal border
LP	=	length from the Protuberantian occipitalis externa to the most aboral point of the Processus frontales of the Incisivum in the medial plane
LS	=	length from the cranial border of the ilia to the Spinae iliocaudales
LV	=	length along the vertebrae, centrally
SB	=	smallest breadth of the Partes glutaeae
SBF	=	smallest breadth between the facets for the costosternal articulations
SC	=	smallest breadth of the corpus

Birds

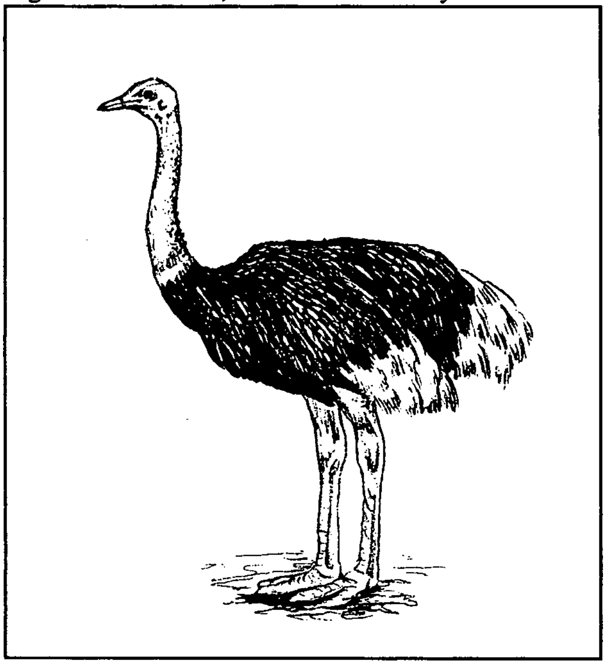
Ostrich, *Struthio camelus syriacus*

The Near Eastern ostrich subspecies (fig. 8.1) has become extinct only within the past few decades (*cf.* Hüe and Etchécopar 1970: 21ff.; Alomía 1978: 300ff.). This 2 m tall, running bird inhabited the far-ranging desert steppes of Palestine (*cf.* Bodenheimer 1960: 59ff.) during the days of ancient Hesban. The few ostrich bones found attest to the fact that it rarely visited the cultivated areas surrounding the cities. The steep slopes descending into the Jordan Valley proved unsuitable for the ostrich. The material available contains four bone fragments (table 8.2).

Table 8.2 Bones of the ostrich, *Struthio camelus syriacus*.

Locus	Dates	Description
H73B.2:73	198-63 B.C.	shaft of Metatarsus III.
H68A.3:8	A.D. 1260-1400	cervical vertebra.
H71A.6:18	A.D. 1260-1400	trochlea of Metatarsus III and posterior Phalanx III (pl. 8.18); GL (92), Bp 39, SC 23.8.

Figure 8.1 Ostrich, *Struthio camelus syriacus.*



If one does not consider the find site locations, then the minimum number of individuals (MNI) is two. However, the distance between Squares A.6 and A.3 (*cf.* Harvey 1973: 22 and fig. 2) suggests a MNI of three. This total is the actual count.

The ostrich was most certainly hunted for its feathers, "the most valuable product of these birds" (von Strassen 1926: 65). Views concerning the flavor of adult ostrich flesh differ (*cf.* Keller 1913: 169; von Strassen 1926: 64; Bodenheimer 1960: 59). The skin could have been used as leather, but that cannot be determined from these bone finds. Neither the cervical vertebra nor the foot bones were surrounded by "flesh" or feathers.

Table 8.3 Bones of the white stork, *Ciconia ciconia.*

Locus	Dates	Description
H73B.2:80	198-63 B.C.	distal two-thirds of a right main metacarpus.
H68C.1:4	A.D. 1260-1400	a carpometacarpus of the same wing as the metacarpus (pl. 8.3); GL 117.5, Bp 24.7.
H74A.9:1	Modern	an leached-out half of a furcula.

White Stork, *Ciconia ciconia*

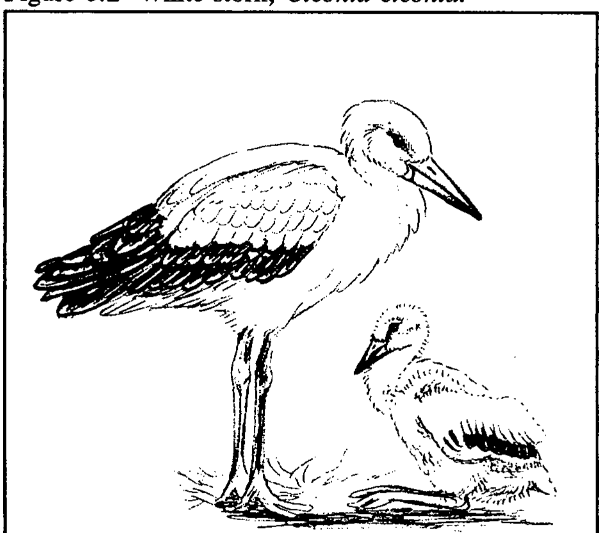
Only three bones belonging to three individual adult white storks were found. Both metacarpels are from large individuals, thus eliminating any confusion with the black stork (*Ciconia nigra*). The three bones are recorded in table 8.3.

The Near Eastern breeding habitat of the white stork (fig. 8.2) extends, at the present time, to Northern Syria and central Iraq (*cf.* Hüe and Etchécopar 1970: 77). If the stork had nested in ancient Hesban, we could expect to find one or more bones from their nestlings, as has been our experience with other breeding birds. As in ancient times, storks today cross Palestine in large groups, migrating through the Jordan Valley (*cf.* Bodenheimer 1935: 141ff.; Grzimek 1968: 211ff.; Alomía 1978: 295). The few bones in our finds simply indicate that no special effort was made to hunt the stork. Only the metacarpus fragment from the Late Hellenistic period possibly comes from the dinner table. This is not certain however. The "Hadschi Lak," which migrated to Mecca was not hunted by the Muslims.

Greater (or Roseate) Flamingo,
Phoenicopterus ruber roseus

The identification of the distal one-third of a metatarsus (H74A.8:1, A.D. 1260-1456 or Modern) from among the finds as flamingo was surprising. The immediate surroundings of Tell Hesban do not provide any shallow lakes in which

Figure 8.2 White stork, *Ciconia ciconia.*



the flamingo could have stayed. If the bird was not imported from the Dead Sea's northern shore, it must have been shot while flying over the Hesban locale. Although flamingo meat is reported to be tasty (von Strassen 1926: 262), the bird was probably killed for its pink feathers (fig. 8.3). Such a singular find lacks the necessary documentation to suppose the bird was slain for its thick, fleshy tongue, which is, according to Keller (1913: 211), exquisitely palatable. If the Mamluks valued this delicacy, as did the Romans, then we should have found a much larger number of flamingo bones.

Domestic Goose, *Anser anser domesticus*

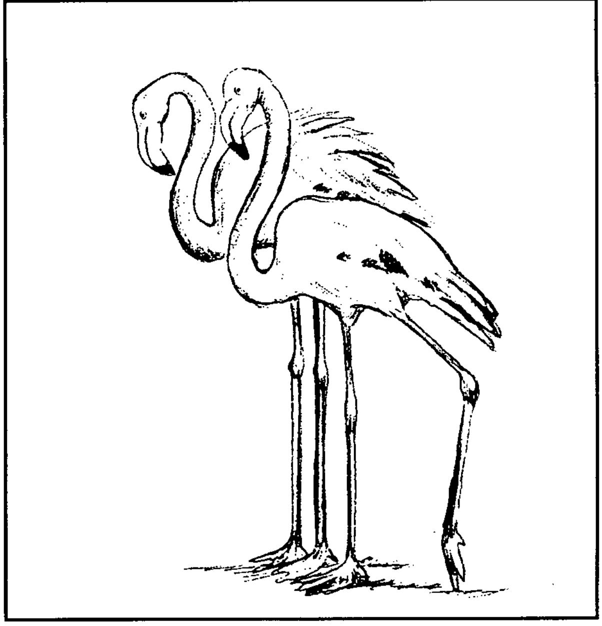
The arid environment around Tell Hesban is ill-suited to the keeping of geese. The present village is an example of all previous habitation periods in that only a few geese are kept. Fifteen mostly fragmentary goose bones were found. They are recorded in table 8.4.

The dating scheme places the earliest find in the Late Hellenistic period. Geese-keeping could also have been expected in the Iron Age, for as discussed elsewhere (Boessneck and von den Driesch 1978: 267; Boessneck and von den Driesch 1981: 60), the domestication of the graylag goose (*Anser anser*) in Egypt is traceable back to the Old Kingdom period (Boessneck 1960, 1962).

Table 8.4 Bones of the domestic goose, *Anser anser domesticus*.

Locus	Dates	Description
H73B.1:138	198-63 B.C.	Metacarpus III.
H71C.1:45	63 B.C.-A.D. 130	Phalanx 1 III posterior; GL 34.3, Bp 10.6, SC 5.1, Bd 6.6.
H73B.3:72	A.D. 130-193	Mandible.
H76D.4:101	A.D. 130-193	Synsacrum.
H76A.9:106	A.D. 193-284	Scapula.
H76C.5:169	A.D. 661-750	Phalanx 1 II anterior; GL 41.5.
H73A.7:28	A.D. 1260-1400	Furcula, middle piece.
H74A.9:18	A.D. 1260-1400	Radius, distal end; Bd 10.
H68C.1:4	A.D. 1260-1400	Femur; GL 82.7, Lm 78.8, Bp 21, Dp 15, SC 8.2, Bd 21.5.
H71D.6:33F	A.D. 1260-1400	Tibiotarsus, without proximal end; Bd 16.9, SC 8.4.
H74A.9:15 and H76C.9:29	A.D. 1400-1456	two radii, proximal ends.
H71C.9:–	A.D. 1200-1456	Coracoid; Lm 66.
H68 (possibly)	–	Ulna, distal end; Dd 14.9.
H68 (possibly)	–	Metatarsus, distal half; Bd 19.6, SC 7.7.

Figure 8.3 Greater (roseate) flamingo, *Phoenicopterus ruber roseus*.



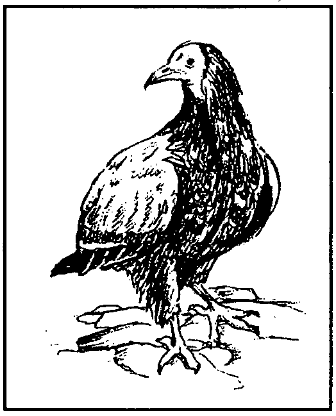
The domestic goose bones in the finds are small-to-medium in size (*cf.* Bacher 1967). Considering local environmental conditions, this is to be expected. Bone size alone would infer the wild graylag goose, which occasionally resides in Palestine as a winter guest. However, a strong argument against this identification is the absence of a large body of fresh water in the Tell Hesban locale, from which the wild geese could search out fields.

Egyptian Vulture, *Neophron percnopterus*

The Egyptian vulture (fig. 8.4) is represented by nine finds encompassing six periods. The bones belong to six or seven individuals, making this bird of prey the most frequently documented one. "As a friend of the oriental way of life," it inhabits any place "where the oriental, in the broadest sense of the word is settled" (von Strassen 1926: 310). By feeding on organic matter (indeed human feces may have been its "primary diet") the Egyptian vulture performed an important hygienic function.

> Almost the entire population is forced to relieve itself in specific places. These locations offer plenty to eat for both the Hoopoe (*Upupa epops*) and the Egyptian Vulture. The former consumes pieces of

Figure 8.4 Egyptian vulture, *Neophron percnopterus*.



tapeworm in, as well as insects on, the feces. The latter eats the fecal material itself. (von Strassen 1926: 311)

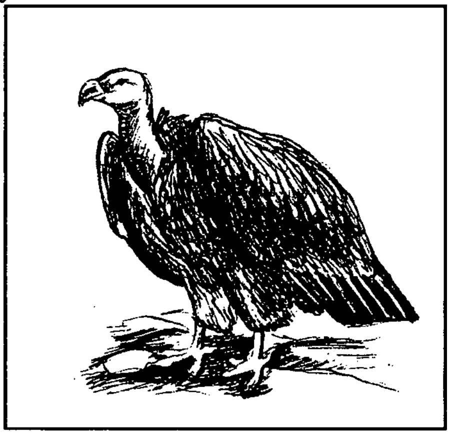
People usually didn't bother the Egyptian vulture, although individual finds from prehistoric and early historic settlements indicate an occasional vulture being hunted or accidentally wounded. This should not imply it was systematically pursued by hunters seeking to obtain, for instance, its pinion feathers. Generally, the Tell Hesban bone finds are fragmentary. Fragmentation resulted from dogs chewing the bones, not from humans carving them. The bones are listed in table 8.5.

Improved refuse disposal methods and unrestricted hunting practices make the Egyptian vulture a rare sight in Palestine today. Alomía observed two vultures flying over Tell Hesban on July 28, 1976, but these birds were the only Egyptian vultures he saw between June 23 and August 11 of that year (Alomía 1978).

Griffon Vulture, *Gyps fulvus*

The griffon vulture (fig. 8.5), "the most striking ornithological feature in Palestine" (Tristram 1884: 95), has also experienced a rapid decrease of its population but still makes an occasional appearance in the vicinity of Tell Hesban. The seven griffon bones could possibly come from two or three individuals.

Figure 8.5 Griffon vulture, *Gyps fulvus*.



A clawbone, pierced on one side, is presently dated to the Umayyad period (H76C.5:177, A.D. 661-750). As previously explained "since the piercing does not go through to the other side of the bone, no thread could have been pulled through" (Boessneck and von den Driesch 1978: 278 and pl. 23.17; Boessneck and von den Driesch 1981: 67).

The other bones could all have come from one, or perhaps two, individuals, although one (H68C.1:1, Phalanx 1, anterior; having a GL of 37.7) is dated to A.D. 1400-1456, while the remaining finds are purported to come from the A.D. 1260-1400 (Early Mamluk) period. This phalanx articulates nicely to a complete carpometacarpus (table 8.6).

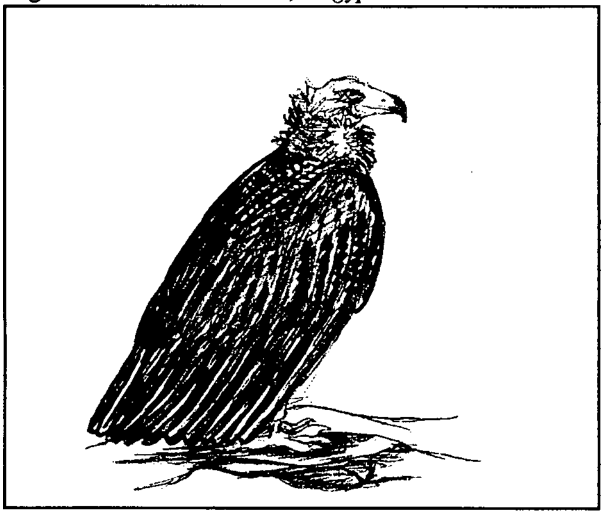
Table 8.5 Bones of the Egyptian vulture, *Neophron percnopterus*.

Locus	Dates	Description
H73B.1:143	700-500 B.C.	Humerus, left proximal half; Bp (31).
H68B.1:49B	198-63 B.C.	Coracoid; Lm (56).
H74B.2:62	63 B.C.-A.D.130	Humerus, right proximal half; Bp (30.5).
H73A.7:47	A.D. 193-365	Radius, distal half; Bd 11.2.
H74A.7:99	A.D. 400-551	Metatarsus, proximal end, and two phalanges belonging to it; Bp 17.3.
H71C.5:3	A.D. 1260-1400	Radius, proximal two-thirds; Bp 8.4.
H76C.8:22	A.D. 1260-1400	Phalanx 1 II, anterior; GL 37.8, GB 12.2.

Table 8.6 Bones of the griffon vulture, *Gyps fulvus*.

Locus	Dates	Description
H76C.5:177	A.D. 661-750	Clawbone, pierced.
H71C.5:2	A.D. 1260-1400	Cervical vertebra.
H71C.5:2	A.D. 1260-1400	Coracoid, Acrocoracoid and Proc. lateralis have been chewed off.
H68C.3:5	A.D. 1260-1400	Ulna, distal end (pl. 8.1), fabrication slice of a small tube; Dd 24.4.
H71C.5:3	A.D. 1260-1400	Carpometacarpus; GL 129.5, Bp 27.8 (pl. 8.2).
H71C.5:2	A.D. 1260-1400	Metatarsus, proximal end cut off, Trochlea broken out.
H68C.1:1	A.D. 1400-1456	Phalanx 1 I, GL 37.7.

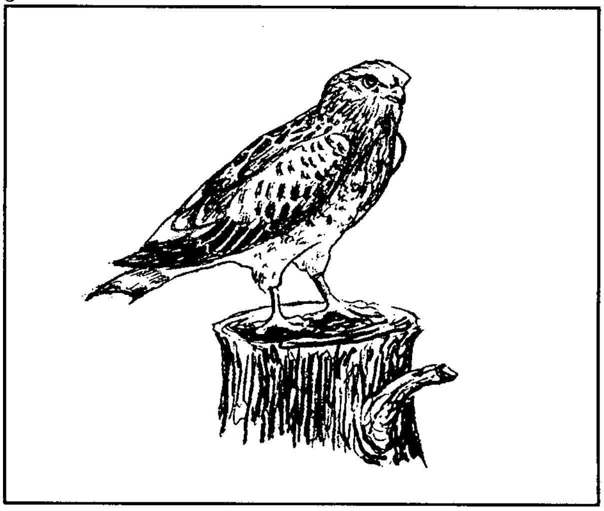
Figure 8.6 Black vulture, *Aegypius monachus*.



The griffon bones are not large. A carpometacarpus from Niederrealta Castle in Graubünden, a Middle Age ruin, has a length of 144 mm (Klumpp 1966-67: 153). A find in Bastam, Iran, has a length of 137 mm (Krauss 1975: 177). The comparable material in our collection varies between 138 mm and 140 mm in length (n=5). Only a carpometacarpus from the Museum of Natural History in Basel was reported by Klumpp (1966-67: 153) to measure 130 mm.

The pinion feathers and hollow bones of a slain griffon vulture would be utilized for the production of panpipe tubes or quills (*cf.* Lund 1973: 23ff.; Lund 1974: 14). This applies particularly to the humerus and ulnae. Comparative ulna finds, also from a griffon vulture, come from the civilian settlement of Hüfingen, Baden-Württemberg (Sauer-Neubert 1969: 113 and figs. 11a-c). However, one can obviously find bones from larger birds which have been worked in a similar manner (*e.g.* Boessneck 1958: 37 and fig. 32; Boessneck and von den Driesch 1979a: 405 and fig. 374ff.).

Figure 8.7 Eurasian short-toed eagle, *Circaetus gallicus*.



Black Vulture, *Aegypius monachus*

After completing our preliminary report, we found two black vulture thoracic vertebrae (H68C.1:6, A.D. 1260-1400) at Andrews University which belong together.

The black vulture (fig. 8.6) is the largest of the three species noted. Even the griffon vulture defers to this scavenger when competing for the same carrion. Unlike the griffon vulture, which builds its nest in inaccessible mountain cliffs, the black vulture nests in trees. As a result, its population is in greater danger, for there are no longer any undisturbed forests in which to seek shelter. Even in earlier periods, however, the black vulture was much rarer than the other two vulture species mentioned (Tristram 1884: 94ff.; Bodenheimer 1935: 160ff.).

Undetermined Eagle

Because sufficient comparative material is lacking, a carpometacarpus from H68C.1:4 (A.D. 1260-1400) can be identified only as belonging to an eagle (pl. 8.4). The bone's size (GL 86.4, Bp 21) suggests it may have come from any one of three birds: a Eurasian short-toed eagle (*Circaetus gallicus* [fig. 8.7]), a female greater spotted eagle (*Aquila clanga* [fig. 8.8]), or a steppe eagle (*Aquila nipalensis* [fig. 8.9]). On the basis of our comparative material, we have ruled out both the lesser spotted eagle (*Aquila pomarina*), and the Bonelli's eagle (*Hieraaëtus fasciatus*), both being too small, and the golden eagle (*Aquila chrysaetos*) and the imperial eagle (*Aquila heliaca*) being too large. Ospreys are discounted, due to morphological considerations.

Because the Eurasian short-toed eagle is a frequent summer bird in Palestine (Tristram 1884: 101; Bodenheimer 1935: 169ff.), and both the greater spotted eagle and the steppe eagle are winter visitors, all three birds must be considered.

Plates 8.1-8.9 **1) Griffon vulture,** *Gyps fulvus*: H68C.3:5; ulna, severed distal end; **2) griffon vulture,** *Gyps fulvus*: H71C.5:3; carpometacarpus, GL 129.5; **3) white stork,** *Ciconia ciconia*: H68C.1:4; carpometacarpus, GL 117.5; **4) possible spotted eagle,** *Aquila clanga*: H68C.1:4; carpometacarpus, GL 86.4; **5a) probable black-bellied sandgrouse,** *Pterocles orientalis*: H73B.4.97; **5.b) rock dove or domestic pigeon,** *Columba livia* (*domestica*): H76A.10:12, sternum, cranial part; **6) cream-colored courser,** *Cursorius cursor*: H73D.2:38; ulna without distal end; **7) stone curlew,** *Burhinus oedicnemus*: H73A.7:1; carpometacarpus, GL 42.2; **8) jackdaw,** *Corvus monedula soemmeringii*: H76C.8.18; carpometacarpus, GL (38); **9a) domestic dove,** *Columba livia domestica*: H71D.6:33; **9b) domestic dove,** *Columba livia domestica*: H71C.4:19; ulna.

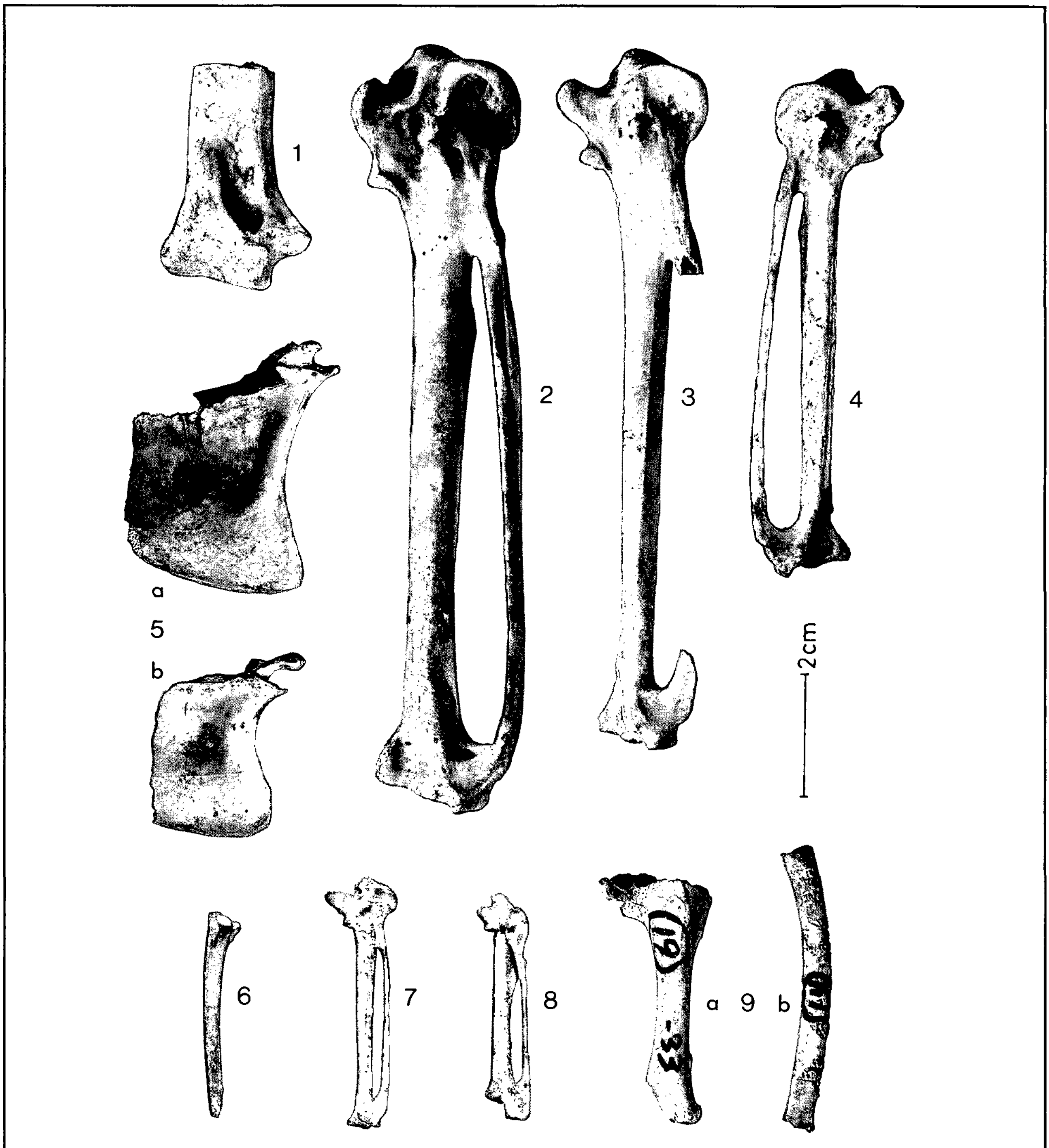
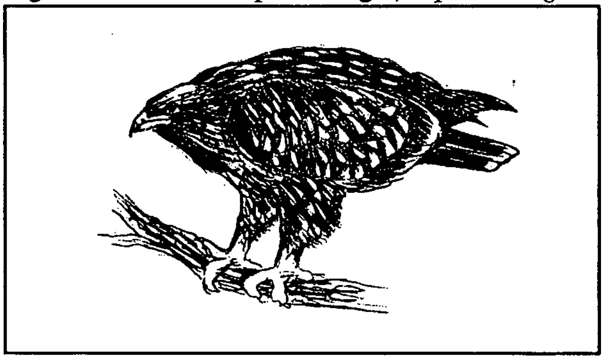


Figure 8.8 Greater spotted eagle, *Aquila clanga*.



The two Eurasian short-toed eagle carpometacarpi available as comparative material have GL 84.7 and 89. The sex of the birds from which these two bones came is unknown. The carpometacarpi appear slimmer than the Tell Hesban find and show slight morphological differences, which allow us to rule out the Eurasian short-toed eagle. Lortet and Gaillard (1909: 140) report a length of 79 mm for the carpometacarpi from a mummy and a more recent Eurasian short-toed eagle; unfortunately, it is not certain whether they are recording the GL.

Although a complete morphological correspondence with the lesser spotted eagle is evident, its carpometacarpus is not so large. Its nearest relative, the greater spotted eagle, also winters in completely barren landscapes (Heinzel *et al.* 1972: 80), something which we ourselves have observed on the border between Syria and Turkey. The spacious fields to the east and south of Tell Hesban offered ample opportunity for the eagle to hunt small rodents. The weaker symphysis between the distal ends of Mc II and Mc III limits the congruence between our find and the steppe eagle carpometacarpus. Therefore we are almost certain the bone is that of a greater spotted eagle.

Figure 8.9 Steppe eagle, *Aquila nipalensis*.

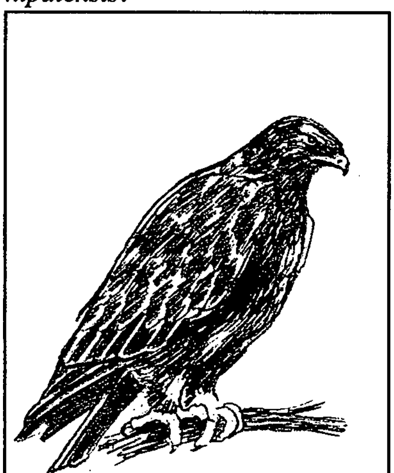
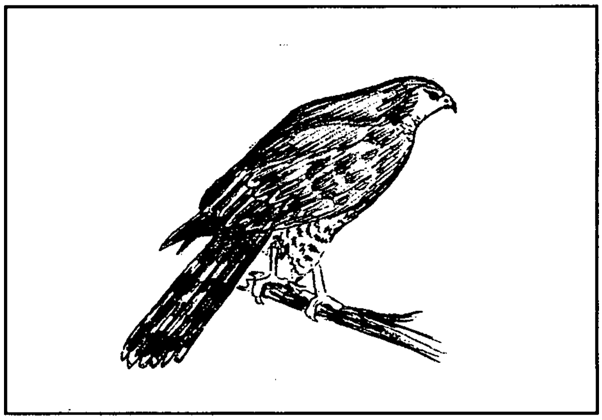


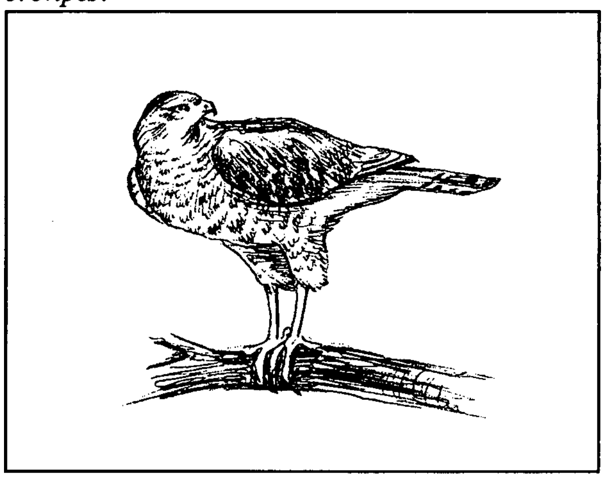
Figure 8.10 European sparrowhawk, *Accipiter nisus*.



European Sparrowhawk, *Accipiter nisus* or Levant Sparrowhawk, *Accipiter brevipes*

Judging by its size, the 2.5 cm long humerus shaft fragment (H74C.3:61, A.D. 1260-1400) mentioned in the preliminary report, is from a female. The European sparrowhawk (fig. 8.10) is not only a migratory bird but also a winter visitor in Palestine. The Levant sparrowhawk (fig. 8.11), on the other hand, is only migratory.

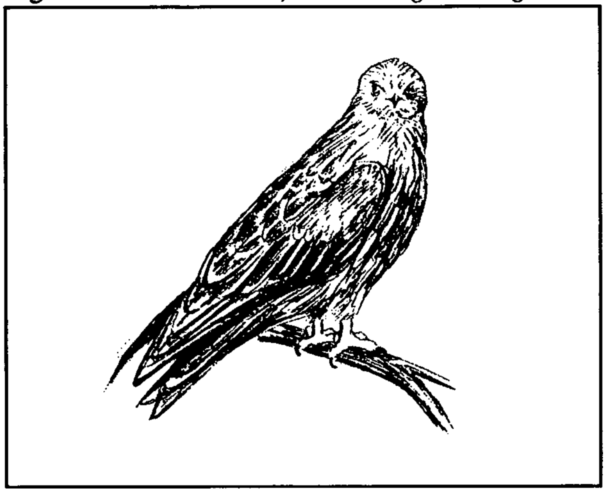
Figure 8.11 Levant sparrowhawk, *Accipiter brevipes*.



Black Kite, *Milvus migrans migrans*

The common black kite (fig. 8.12) is represented in our material by a single find: a nestling's metatarsus (H76C.7:62, A.D. 365-400). The bone is too large to be from *Milvus migrans aegyptius*. Perhaps the black kite, which is a

Figure 8.12 Black kite, *Milvus migrans migrans*.



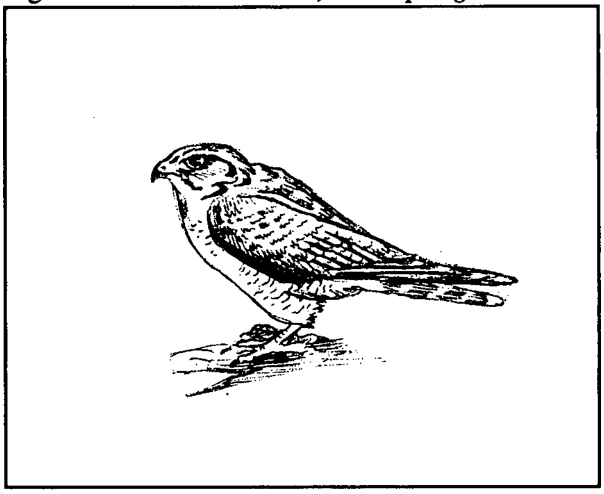
civilization follower in Palestine (Bodenheimer 1935: 169), built its nest in the town out of which the young bird fell.

Great Falcon, *Falco* Species

The proximal part from an approximately four week old falcon humerus held a special interest in previous discussions (Boessneck and von den Driesch 1978: 281ff. and pl. 23.18; Boessneck and von den Driesch 1981: 68). Initial dating placed the bone in the Abbasid period (A.D. 750-969), but the finds from Locus H73C.2:9 are not as yet conclusively dated (*cf.* Mare 1978: 53). If the bone is a cultural product, then the bird could have been removed from its nest in order to be trained for hunting.

Figure 8.13 Peregrine falcon, *Falco peregrinus*.

Figure 8.14 Desert falcon, *Falco pelegrinoides*.



Much is written about "de arte venandi cum avibus" ("the art of hunting with birds"), as the emperor Frederick II of Hohen-Stauber titled his famous book on falcons (*e.g.*, Hehn 1911: 374ff.; Keller 1913: 23ff.; Zeuner 1967: 385ff.). Falconry is still the sport of kings, especially in Arabian countries, although there soon will be neither falcon nor game left to hunt.

The following falcon species all breed in the Hesban region and thus merit our attention (Hüe and Etchécopar 1970: 189ff.): the peregrine falcon (*Falco peregrinus* [fig. 8.13]), the desert falcon (*Falco pelegrinoides* [fig. 8.14]), and the Lanner falcon (*Falco biarmicus* [fig. 8.15]). The latter species is the most common of the three in Palestine (Tristram 1884: 104ff.). Per Weick (1980), the desert falcon is the smallest (table 8.7).

Figure 8.15 Lanner falcon, *Falco biarmicus*.

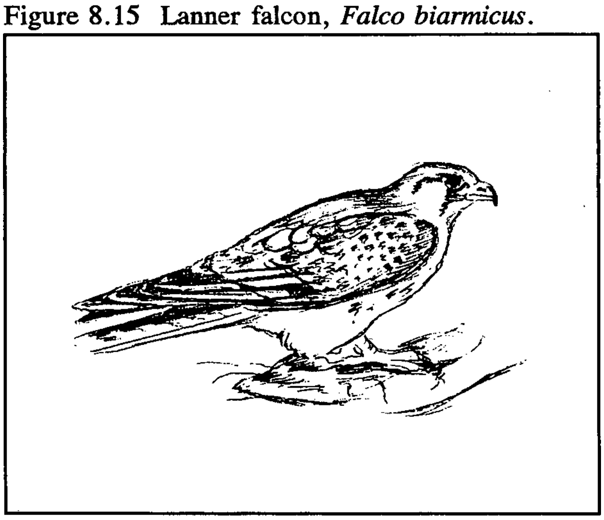


Table 8.7 Wing length of *Falco* species.

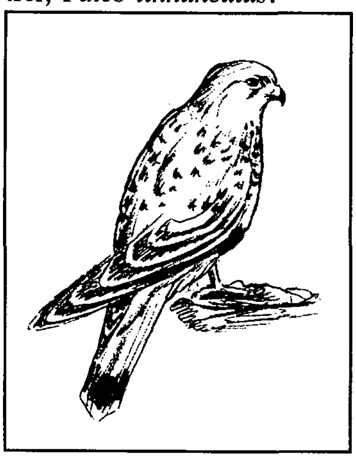
Species	Lengths (in mm) Male	Female
Falco peregrinus peregrinus	289-334	339-375
Falco peregrinus brookei	280-312	306-355
Falco pelegrinoides pelegrinoides	260-293	282-332
Falco biarmicus feldeggii	308-335	345-375
Falco biarmicus tanypterus	314-338	353-375

Comparative material shows that the size of the humerus find corresponds to that of the female peregrine falcon. Contrary to our original supposition, the Lanner falcon could also reach such humerus size; a female of either species conforms best to their characteristics of our find. Alomía (1978: 295) reports observing a Lanner falcon over Tell Jalul, and Tristram tells how this falcon builds its nest "in the ravines of Moab" and "is highly esteemed by the Arab falconers, who train the young birds for the chase of the Hare and the Bustard" (1884: 104ff.).

Old World (Eurasian) Kestrel, *Falco tinnunculus*

This bird (fig. 8.16) is the most common falcon found near Tell Hesban. We analyzed a pair of humeri of an adult animal and a distal ulna half, the porous bone surface of which identifies it more properly as a subadult. Although exact dating of the finds is difficult, all three bones appear to come from the Mamluk period. The left humerus (H76G.4:52, A.D. 1400-1456) has a locus dated differently from the right humerus (H76G.4:53, A.D. 1260-1400), even though size and morphological characteristics very definitely indicate that they belong together: GL 52.9 and 52.6, SC 4.6 for both, Bd 10 and 10.1, respectively. The ulna from H73A.8:8 (A.D. 1260-1400) has Dd of 6.4.

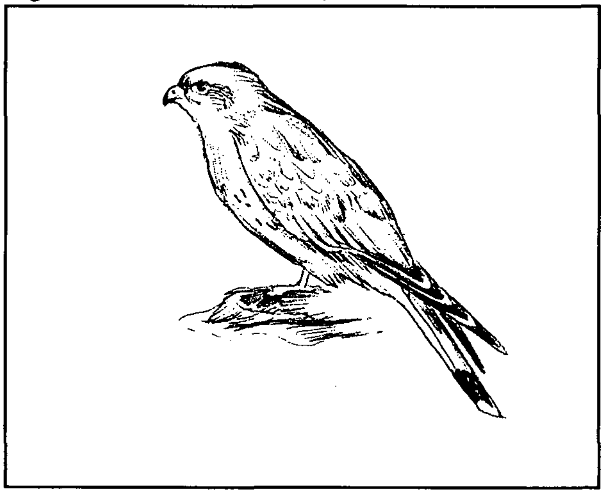
Figure 8.16 Eurasian kestrel, *Falco tinnunculus*.



Lesser Kestrel, *Falco naumanni*

Initially, a small kestrel species' femur minus its distal end (H76A.10:4, A.D. 1400-1456 or Modern; Bp 6.9, Dp [4.2]) could not be identified with certainty. Further additions to our comparative collection have now facilitated definite identification. The bone comes from the lesser kestrel (fig. 8.17), a summer bird around Tell Hesban (*cf.* Tristram 1884: 106).

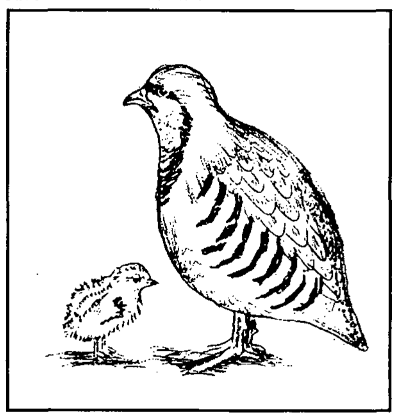
Figure 8.17 Lesser kestrel, *Falco naumanni*.



Chukar Partridge, *Alectoris chukar*

The partridge (fig. 8.18), "the game bird par excellence" (Tristram 1884: 123; Bodenheimer 1960: 58), still lives in the Wadi el-Majarr below present-day Hesban where it is not so easily hunted (*cf.* Alomía 1978: 296). The partridge provided a delicious alternative to the normal table fare throughout all settlement periods. With the exception of the domestic chicken, the partridge is by far the most numerous species represented in the finds.

Figure 8.18 Chukar partridge, *Alectoris chukar*.



According to LaBianca (1973: 140), the following number of finds are noted for the five most frequent avian species: domestic chicken (2473), partridge (229), domestic pigeon or rock dove (137), starling (30), and corncrake (20). See table 8.8.

Table 8.8 Bird, reptile, and amphibian species found at Tell Hesban.

Species	Number of bones	MNI
Birds		
ostrich, *Struthio camelus syriacus*	4	6
white stork, *Ciconia ciconia*	3	3
flamingo, *Phoenicopterus ruber roseus*	1	1
domestic goose, *Anser anser domesticus*	15	7
Egyptian vulture, *Neophron percnopterus*	9	6
griffon vulture, *Gyps fulvus*	7	2-3
black vulture, *Aegypius monachus*	2	1
eagle species	1	1
European sparrowhawk, *Accipiter nisus*, or Levant sparrowhawk, *Accipiter brevipes*	1	1
black kite, *Milvus migrans migrans*	1	1
great falcon, *Falco* species	1	1
kestrel, *Falco tinnunculus*	3	2
lesser kestrel, *Falco naumanni*	1	1
chukar partridge, *Alectoris chukar*	229	56
Arabian sand partridge, *Ammoperdix heyi*	1	1
quail, *Coturnix coturnix* (partial skeleton)	9	
domestic chicken, *Gallus gallus domesticus*	2473	219
crane, *Grus grus*	1	1
corncrake, *Crex crex*	20	9
coot, *Fulica atra*	3	3
great bustard, *Otis tarda*	4	3
Houbara bustard, *Chlamydotis undulata*	14	6
cream-colored courser, *Cursorius cursor*	2	2
stone curlew, *Burhinus oedicnemus*	2	1
black-bellied sandgrouse, *Pterocles orientalis*	2	2
domestic pigeon, *Columba livia domestica*, & rock dove, *Columba livia*	137	31
laughing dove, *Streptopelia senegalensis*	3	3
barn owl, *Tyto alba*	1	1
little owl, *Athene noctua lilith*	21	4
short-toed lark, *Calandrella brachydactyla*, or lesser short-toed lark, *Calandrella rufescens*	1	1
crested lark, *Galerida cristata*, or skylark, *Alauda arvensis*	4	3
woodlark, *Lullala arborea*	1	1
warbler, *Hippolais* species	1	1
Isabelline wheatear, *Oenanthe isabellina*	2	2
medium-sized wheatear, *Oenanthe* species	2	2
blackbird, *Turdus merula*	1	1
corn bunting, *Emberiza calandra*	2	2
medium-sized bunting, *Emberiza* species	3	2
house sparrow, *Passer domesticus*	6	4
rock sparrow, *Petronia petronia*	5	1
common starling, *Sturnus vulgaris*, or rose-colored starling, *Sturnus (Pastor) roseus*	30	10
jackdaw, *Corvus monedula soemmeringii*	3	3
brown-necked raven, *Corvus ruficollis*	3	3
common raven, *Corvus corax subcorax*	10	4
Reptiles and Amphibians		
tortoise, *Testudo graeca terrestris*	91 +3 skeletons	36
hardoun, *Agama stellio*	13	9
scheltopousik, *Ophisaurus apodus*	1 skeleton	
racer, *Coluber* species	23 +1 skeleton	5
variegated toad, *Bufo viridis*	71	14

Table 8.9 Partridge bone distribution by period.

Period	Date	No.	MNI[1] adlt	sub	juv	inf
Mod/undated	--	38	2	1	1	1
Mamluk	A.D. 1260-1456	101	11	-	4	6
Ayyubid	A.D. 1200-1260	5	2	-	-	-
Abbasid	A.D. 750-969	7	2	-	-	-
Umayyad	A.D. 661-750	11	2	-	-	2
Byzantine	A.D. 365-661	9	3	-	-	1
L. Roman	A.D. 130-365	31	6	1	1	1
E. Roman	63 B.C.-A.D. 130	8	2	-	-	1
L. Hellenistic	198-63 B.C.	13	3	-	1	-
Iron	1250-6th Cent. B.C.	6	2	-	-	-
Total		229	35	2	7	12

[1]MNI = minimum number of individuals; adlt = Adults; sub = subadults; juv = juveniles; inf = infants

Most of the partridge bones, like most of the finds, come from the Mamluk period (table 8.9). A single partridge pelvis dates from the early Iron Age (1250-1200 B.C.). Five bones date from the mid-11th to 10th century B.C. period. The partridge finds become more numerous in the Late Hellenistic and Roman period strata, but are a rarity in the Byzantine period (table 8.9).

Based on the number of bones, one-fourth of the total quantity are those of young animals (table 8.10). However, on the basis of the MNI, this figure increases to one half (table 8.9). Some individuals counted as adult are possibly unrecognized subadults.

In 1976, bones belonging together were found in several places throughout Sounding G.4 (table 8.11).

Table 8.10 Partridge bone distribution according to skeletal parts.

Skeletal part	Adult/ subadult	Juvenile/ infant
Cervical vertebrae	2	-
Synsacrum & pelvis	8	1
Sternum	11	3
Coracoid	24	-
Furcula	6	1
Scapula	9	3
Humerus	22	4
Radius	5	2
Ulna	9	6
Carpometacarpus	5	2
Femur	11	16
Tibiotarsus	41	16
Tarsometatarsus	11	8
Phalanx 1 anterior	1	-
Phalanx 1 posterior	1	1
Total	166	63

Table 8.11 Bones of the chukar partridge, *Alectoris chukar*, from Sounding G.4 in 1976.

Locus	Dates	Description
H76G.4:26	A.D. 1400-1456	Two humeri; right femur; left tibiotarsus, adult.
H76G.4:42	A.D. 1260-1400	Sternum, furcula, scapula, ulna, metacarpus, two left femora, left and right tibia, and left and right metatarsus from two infants.
H76G.4:49	A.D. 1260-1400	Ulna, femur, left and right tibia of an infant.

Presumably, these bones are partridge remains which were deposited whole or decapitated. This fact was not mentioned in the excavation report (Wimmer 1978).

Table 8.12 records comparable measurements for partridge bone sizes. The considerable size variations are due to sexual dimorphism, as the tarsometatarsi clearly reveal. Sex identification on this skeletal part is easy to determine, for the male bones have spurs, while the female ones do not. Mean value calculations based on measurements were affected by the greater number of male or female bones in the measurement groups. Little can be done with these values mathematically. Nevertheless, there is some value in detailing the range of partridge variation. The Tell Hesban finds offer the largest series thus far for this purpose (*cf.* Boessneck and von den Driesch 1975: table 41; Krauss 1975: table 54; Boessneck and Kokabi 1981, 1988). The bone lengths may be confused with those of the small domestic chicken (*cf.* table 8.12 with Lindner 1979: table 6), but this is unlikely when bone breadths are considered, since partridge bones are more slenderly built.

Table 8.12 Bone measurements of the chukar partridge, *Alectoris chukar*.

a) Coracoid

Loc	B.2:124	B.3:63	B.1:123	G.1:30	C.10:40	B.1:4	A.9:89	C.3:16	C.2:18	C.3:53	A.7:64	A.9:73	G.12:6	C.6:46	D.3:9	A.10:4	A.4:1
Strat	15	15	15	13	12	9	6	6	5	5	5?	3	3	3	3	2?	1
GL	-	41.6	41.3	41.1	41.8	37.6	40.1	38	40.5	40.3	39.1	43.5	(42.3)	40.5	-	40.7	(41.5)
Lm	40.6	40.4	40.3	39.2	40.2	36.5	39.2	36.3	39	39.1	37.8	42.5	41	39	(35)	39.4	40.1
Bb	-	11.8	-	12.5	-	11.8	12.7	11.4	-	11.5	11.1	11.2	-	-	-	-	-
BF	-	(8.7)	8.8	8	8.7	7.8	8.7	(7.5)	8.5	7.2	7.6	8.5	8	8.3	-	(8)	-

b) Humerus

Loc	A.7:54	D.5:5	D.2:41	D.6:4	G.4:26		C.2:9	n	Variation	$\bar{X}$	S
Strat	6	2/3	3	3	2		?				
GL	(47.2)	53.2	53.5	49.2	48.2	48.1	50.6	7	(47.2)-53.5	50.0	2.52
Bp	13.2	14.6	14.3	13.7	13.8	14	14.5	9	13.2-14.6	14.1	0.40
SC	4.2	4.8	4.7	4.4	4.5	4.5	4.9	14	4.2-4.9	4.6	0.22
Bd	-	10.8	11.3	10	10.1	10	10.7	14	10.0-11.3	10.5	0.39

c) Radius

Loc	C.1:48	C.7:51	A.10:11	A.10:13	?
Strat	13	6	3	3	?
GL	41.6	47.4	44.7	44	42.8

d) Ulna

Loc	D.2:52	D.2:28	C.2:2	C.2:9	n	Variation	$\bar{X}$	S
Strat	3	3	2	?				
GL	51	46.5	52.5	48	4	46.5-52.5	49.5	2.74
Bp	7	6	7	6.3	5	6.0-7.0	6.7	0.48
SC	3	2.8	3.3	2.8	6	2.8-3.3	3.0	0.20
Dd	7.5	6.7	8	6.8	6	6.3-8.0	7.1	0.62

e) Carpometacarpus

Loc	C.3:13	D.6:65	D.6:36	D.2:16
Strat	6	6	3	3
GL	31.3	31	30.5	30
Bp	8.5	8.5	8	8.4

f) Femur

Loc	B.2:133	D.2:36	D.6:33F	C.4:22	A.9:51	G.4:26	n	Variation	$\bar{X}$	S
Strat	15	11	3	3	3	2				
GL	-	-	-	58.2	(56.5)	56.3	3	56.3-58.2	57.0	1.04
Lm	54	(56.5)	58.6	55.4	-	53.4	5	53.4-58.6	55.6	2.08
Bp	11.5	11.3	-	11.5	12.5	11.5	7	11.3-12.5	11.9	0.56
Dp	-	7.5	-	7.7	7.9	7.5	6	7.5-8.3	7.8	0.26
SC	4.4	4.5	4.7	4	4.3	4.5	9	4.0-4.7	4.4	0.24
Bd	10.2	-	11.6	10.3	-	10.4	6	10.2-11.6	10.9	0.64
		subad								

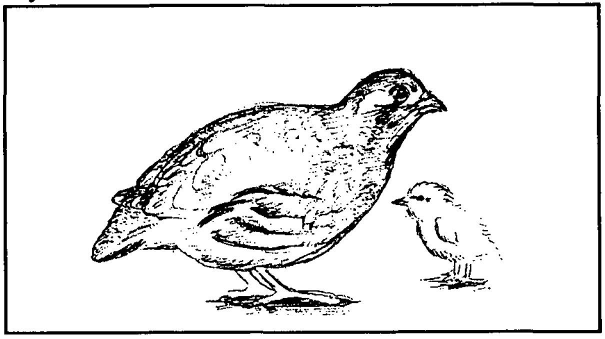
g) Tibiotarsus

Loc	B.2:94	D.1:48	D.6:33F	G.4:26	C.3:12	n	Variation	$\bar{X}$	S
Strat	15	13	3	2	?				
GL	-	78.2	84.5	75.3	75.5	4	75.3-84.5	78.4	4.23
La	78.5	76.3	82.5	73.5	73.5	5	73.5-82.5	76.9	3.79
Dp	-	13	13.8	12.7	-	5	12.6-13.8	13.1	0.49
SC	4.1	4	4.5	3.8	3.7	26	3.6-4.5	4.0	0.26
Bd	8.3	7.7	8.5	7.7	7.6	28	7.1-8.5	7.8	0.47

h) Tarsometatarsus

Loc	A.6:74	C.1:7	A.6:30A	C.3:61	C.3:61	A.6:46	n	male Variation	$\bar{X}$	n	female Variation	$\bar{X}$
Strat	14	6	4	3	3	?						
Sex	M	F	F	F	?	M						
GL	(49)	(44.5)	43.8	43.5	-	(49)	2	(49)-(49)	49	3	43.5-(44.5)	43.9
Bp	(8.8)	8.7	8.4	7.8	-	8.8	3	8.7-8.8	8.8	5	7.8-8.9	8.4
SC	4	3.6	3.6	3.6	4	4	3	4.0-4.0	4.0	5	3.5-3.8	3.6
Bd	9.9	-	8.7	8.6	8.3	-	1	-	9.9	2	8.6-8.7	-

Figure 8.19 Arabian sand partridge, *Ammoperdix heyi.*



Arabian Sand Partridge, *Ammoperdix heyi*

A leached-out sand partridge femur (H76C.7:62, A.D. 365-400) measuring GL (42), Lm (39.5), Bp (8.5), and SC (3.3), is definitely too small to be chukar partridge and too large to be quail. Femur identification as sand partridge was established by comparing it with a female *Ammoperdix griseogularis*, since comparative material for the Arabian sand partridge (fig. 8.19) was not available. Steep canyons on the Jordan Valley's eastern edge, west of Tell Hesban, may even now shelter this bird (*cf.* Tristram 1884: 123; Bodenheimer 1935: 172).

Common Quail, *Coturnix coturnix*

Only nine common quail (fig. 8.20) bones were found: neurocranium, furcula, coracoid, scapula, humerus, ulna, carpometacarpus, tibiotarsus, and tarsometatarsus. All belonging to the same skeleton, they were deposited either in Modern times or during the Late Mamluk period (H74A.9:9/10). Both this incomplete skeleton and one from a little owl were found in the same spot, but the quail bones do not appear to have been from the owl's casting. Except for the tibia's proximal end, the bones are well preserved. The measurements are found in table 8.13.

Figure 8.20 Common quail, *Coturnix coturnix.*

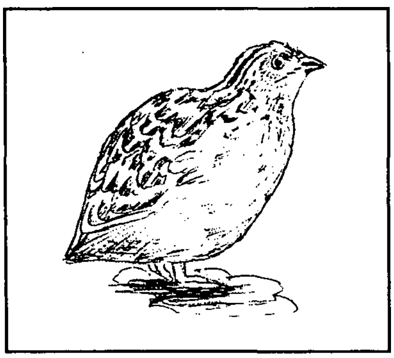


Table 8.13 Bone measurements of the common quail, *Coturnix coturnix.*

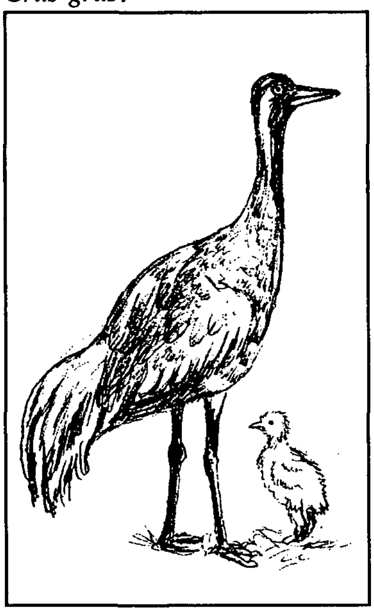
Bone	Measurements
Neurocranium	LP 22.8, GB 17.9, GH 13.5.
Coracoid	GL 23.8, Lm 22.5, Bb 7.6, BF 5.5.
Humerus	GL 34.6, Bp 7.9, SC 2.3, Bd 5.5.
Ulna	GL 30.2, Bp 3.6, SC 1.5, Dd 3.7.
Carpometacarpus	GL 19.2, Bp 4.8.
Tibiotarsus	SC 2.2, Bd 4.3.
Tarsometatarsus	GL 27.6, Bp 4.6, SC 2.1, Bd 5.

This singular find prohibits any discussion concerning the function of the quail. We do not know whether it was eaten, kept as a pet, or used in cockfights (*cf.* Keller 1913: 161ff.; Bodenheimer 1960: 59). One reason for the rarity of quail in pre- and early-historic finds is their small size. Their bones can seldom be measured (Dräger 1964: 23; Krauss 1975: 182; Wessely 1975: 140; von den Driesch and Boessneck 1976: 100; Boessneck and Kokabi 1981, 1988).

It is almost certain that the common quail breeds in the fields surrounding Tell Hesban today, although the large migratory flocks of former times (Bodenheimer 1935: 143ff.) have now been reduced to far smaller numbers. Even during winter, one may occasionally see quails.

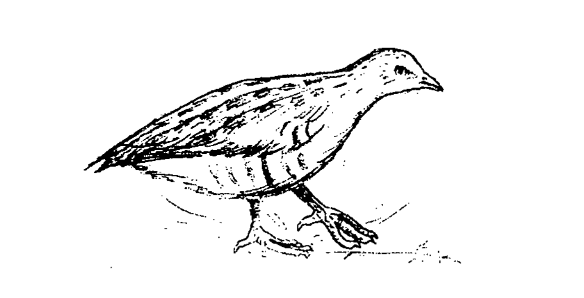
Common Crane, *Grus grus*

Figure 8.21 Common crane, *Grus grus.*



The crane (fig. 8.21) is a migratory bird in Palestine and probably wintered in the Jordan Valley. After surveying all available finds, it appears that no more than one crane fragment is present in the Tell Hesban finds, that being a tibiotarsus' dorsal end (H76 C.1:126; BD

Figure 8.22 Corncrake, *Crex crex*.



ca. 20 mm) dating from the mid-11th to 10th century B.C. This bone has had its dorsal, lateral, medial, and distal parts ground off (see Boessneck and von den Driesch 1978: pl. 23.16). This fact can hardly be attributed to sectioning. While it is true that the condyle may also be removed when the foot is amputated at the tarsal joint, such an amputation would not include both sides and/or the bone's dorsal part, as evidenced here. Consequently, the bone must have been used as a tool.

Corncrake, *Crex crex*

Corncrake (fig. 8.22) bones are noticeably numerous in our finds, with 20 pieces presently available. Two fragments were found which belonged to the same bone. This reduced by one the previously reported 21 bone pieces. In former times, the corncrake was a frequent migratory visitor, but today is rarely found in Palestine. The majority of the corncrake remains come from the Roman period, even though most bones in the finds date from the Mamluk period. A list of corncrake bones follows in table 8.14.

Table 8.14 Bones of the corncrake, *Crex crex*.

Dates	Description
mid-11th to 10th c. B.C.	Scapula.
63 B.C.-A.D. 130	Humerus, tarsometatarsus (MNI=1).
A.D. 130-193	Humerus, femur, left and right tibiotarsus (MNI=1).
A.D. 193-284	Sternum, humerus, carpometacarpus (MNI=1).
A.D. 284-365	Tibiotarsus.
A.D. 365-400	Tibiotarsus.
A.D. 661-750	Tibiotarsus.
A.D. 1260-1400	Humerus, tibiotarsus, two tarsometatarsi (MNI=2).
Undated period	Ulna, femur, tarsometatarsus.

As shown above, a minimum of ten bones from at least four individuals date to the Roman period. Only four bones from two birds belong to the Mamluk period. All bones are fragmentary, with the exception of two tarsometatarsi. The humeri and tibiotarsi proximal and distal ends are broken off; the femora and ulna, almost completely destroyed. These indicators are precisely what is expected from dietary remains. The measurements presented in table 8.15 provide a basis for comparative study with future corncrake remains.

Table 8.15 Bone measurements of the corncrake, *Crex crex*.

a) Humerus

Loc	D.3:99	C.5:166	D.3:57D	C.5:87
Strat	13	12?	14	3
DP	10	9	-	-
Bp	9	8.7	-	-
SC	2.8	-	2.8	2.6
Bd	-	-	6	5.8

b) Carpometacarpus

Loc	C.10:40
Strat	12
Bp	5.7

c) Tibiotarsus

Loc	C.8:34
Strat	3
Bp	8
SC	2.7

d) Tibiotarsus

Loc	B.7:33	D.4:101	D.2:36	C.7:57	C.3:57
Strat	13	13	11	10	6
SC	2.8	2.7	2.8	2.8	2.8
Bd	5.4	5.4	5.2	5.3	5.3

e) Tarsometatarsus

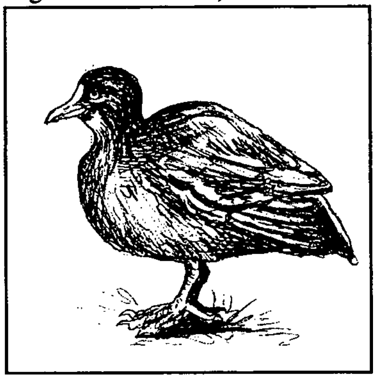
Loc	?	B.4:90	D.6:36
Strat	?	14	3
GL	41.3	39.4	39.3
Bp	5.7	5.4	5.9
SC	2.5	2.5	2.7
Bd	-	5.8	5.9

Coot, *Fulica atra*

The three coot (fig. 8.23) bones are from three different periods. The fragmentary condition of the bones suggests they might have been table scraps (table 8.16).

The measurable humerus is small (*cf.* Clason 1967: table 95; Boessneck 1976: 35; Kokabi 1980: table 10). The second humerus is medium-sized. In all probability the small humerus is female, since coot hens are smaller than coot cocks (Glutz von

Figure 8.23 Coot, *Fulica atra*.



Blotzheim *et al.* 1973: table 17). The coot cannot be confused with the common moorhen (*Gallinula chloropus*) which is clearly smaller.

The coot inhabits inland waters rich in vegetation, but can also be content with waterholes surrounded by thickets, as is the case with Ain Hesban, a spring located 3 km north of Tell Hesban on the slopes descending into the Jordan Valley (*cf.* Alomía 1978: 290ff., 301).

Table 8.16 Bones of the coot, *Fulica atra*.

Locus	Dates	Description
H76C.1:131	1150-900 B.C.	Ulna diaphysis.
H74B.4:232	63 B.C.-A.D. 130	Humerus.
H71B.4:14	A.D. 1200-1260	Humerus, distal half; Bd 9, SC 4.

Great bustard, *Otis Tarda*

In our preliminary report (Boessneck and von den Driesch 1978: 281, 1981: 68), we noted with special interest the presence of four great bustard (fig. 8.24) bones in our finds, stating that "even today great bustards occasionally move southward to the open fields of Moab during the winter."

Figure 8.24 Great bustard, *Otis tarda*.

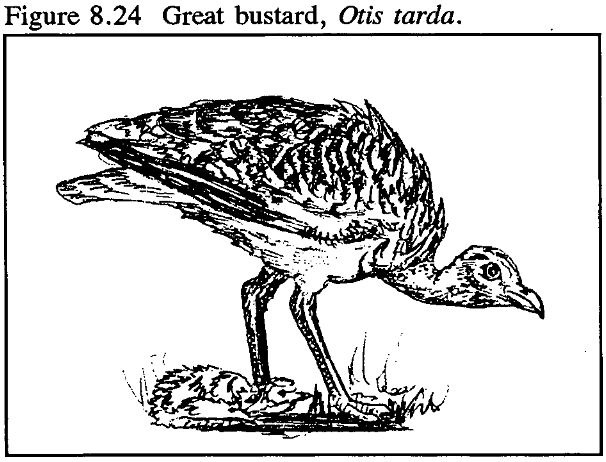


Table 8.17 Bones of the great bustard, *Otis tarda*.

Locus	Dates	Description
H76C.1:140	1150-900 B.C.	Metatarsus, proximal end (Boessneck and von den Driesch 1978: pl. 23.15; Boessneck and von den Driesch 1980); Bp 20.2, female.
H74B.4:205	198-63 B.C.	Sternum and distal third of radius; Bd 18, subadult, male.
H76B.4:283A	A.D. 1260-1400	Femurcorpus, male.

However, a change has taken place subsequent to the bone datings. It now appears that one bone belongs to the Mamluk rather than to the Roman period. A bone list is in table 8.17.

The meat of young great bustards is "generally regarded as being delicious" (Keller 1913: 176ff.; similarly, von Strassen 1926: 206). The Hesban bone fragments are undoubtedly kitchen remains.

Houbara Bustard, *Chlamydotis undulata*

Until recently, the common bustard species in the Jordanian desert and semidesert regions was the Houbara bustard (fig. 8.25). It is now a rarity in Jordan, but the relatively high proportion of finds (14 bones) attests to its former abundance. A list of the bones is found in table 8.18.

The MNI are: one animal from the Late Hellenistic period; one female from the Umayyad

Figure 8.25 Houbara bustard, *Chlamydotis undulata*.

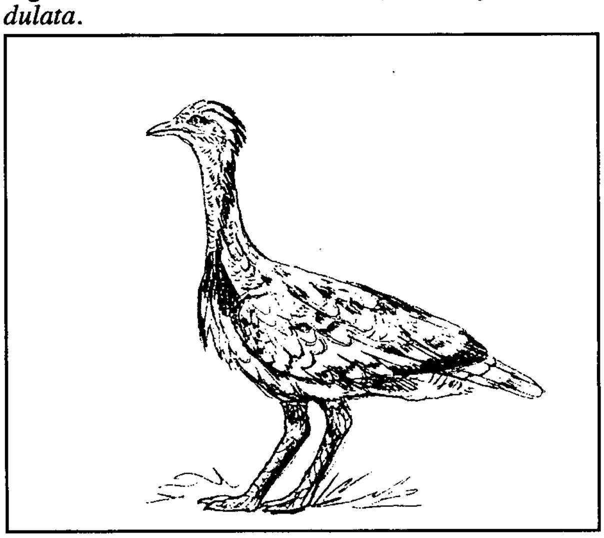


Table 8.18 Bones of the Houbara bustard, *Chlamydotis undulata*.

Locus	Dates	Description
H74D.3:94	A.D. 193-284	Radius, proximal end.
H73A.7:54	A.D. 661-750	Humeruscorpus, female.
H71D.6:51	A.D. 1200-1260	Scapula, female.
H71D.6:33	A.D. 1200-1400	Humerus without caput, male; two Femorae without trochlea, male and female (pls. 8.20a, b).
H74A.9:51	A.D. 1260-1400	Carpometacarpus.
H73A.7:48	A.D. 1260-1400	Tibiotarsus without proximal end, female.
H76A.10:25	A.D. 1260-1400	Tibiotarsuscorpus, male.
H71D.6:5	A.D. 1400-1460	Femur, proximal half, male.
H74C.7:1	A.D. 1400-1460	Metatarsus, distal half, male (Boessneck and von den Driesch 1978: pl. 23.14b; Boessneck and von den Driesch 1980).
H68A.3:1	A.D. 1870-1976	Tarsometatarsus, proximal third, male.
H68A1.(locus missing)		Radius, proximal half; Tarsometatarsus, female (Boessneck and von den Driesch 1978: pl. 23.14a; Boessneck and von den Driesch 1981: 60 and fig. 14a).

period; one male and one female from the Ayyubid-Early Mamluk period; one male from the Late Mamluk period; and one male from the Modern period. The undated finds might belong to any of these six individuals.

Some bones show definite cut marks, believed to result from carving. A striking example is a female femur with a severed distal end (pl. 8.20b; D.6:33). Relatively few measurements could be taken, due to the bones' broken condition (table 8.19).

Cream-colored Courser, *Cursorius cursor*

The cream-colored courser (fig. 8.26) usually inhabits desert and semidesert regions. Two bones represent this bird, an ulna lacking the distal end (H73D.2:38, A.D. 1260-1400, Bp 5.5; pl. 8.6) and a metatarsus without the proximal end (J.13:10, almost certainly recent, Bd 5, SC 2). Identification was possible only after we acquired comparable

Table 8.19 Bone measurements of the Houbara bustard, *Chlamydotis undulata*.

a) Humerus

Loc	D.6:33
Strat	3/4
Sex	M
Bd	21.3
SC	9.1

b) Radius

Loc	D.3:94	A.1:?
Strat	12	?
Bp	7.4	7.3

c) Carpometacarpus

Loc	A.9:51
Strat	3
GL	59.9
Bp	15.7

d) Femur

Loc	D.6:33	D.6:33	D.6:5
Strat	3/4	3/4	2
Sex	M	F	M
Bp	(19.8)	16.5	19.7
SC	7.5	7	-

e) Tarsometatarsus

Loc	C.7:1	A.3:1	?
Strat	2	1	?
Sex	M	M	F
GL	-	-	85
Bp	-	15	-
SC	-	-	4.7
Bd	16	-	-

material for this species. The ulna was previously considered as evidence of a dotterel (*Eudromias morinellus*); unfortunately, we do not have any comparative material for this bird at our disposal.

Stone Curlew, *Burhinus oedicnemus*

The stone curlew (fig. 8.27), which lives in wastelands, steppes, and semideserts, is active at night. Two bones from this species were found: a carpometacarpus (H73A.7:1, Modern disturbance, GL 42.2, Bp 11.9; pl. 8.7) and a tibiotarsus (H73A.7:7, A.D. 1260-1400). Large pieces are missing from the tibiotarsus' proximal and distal ends. It may have belonged to an animal once served as table fare, for the stone curlew's meat is said to be "very delicious" (von Strassen 1926: 307).

Figure 8.26 Cream-colored courser, *Cursorius cursor*.

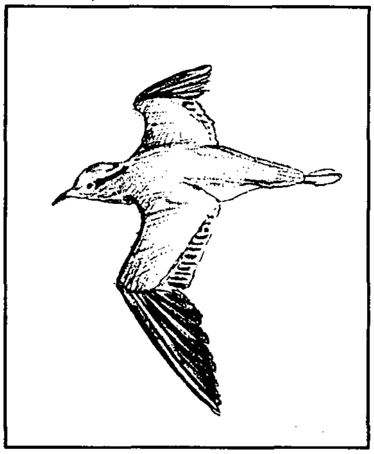
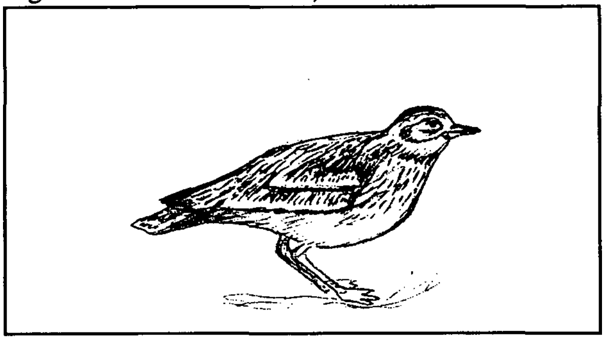


Figure 8.27 Stone curlew, *Burhinus oedicnemus*.



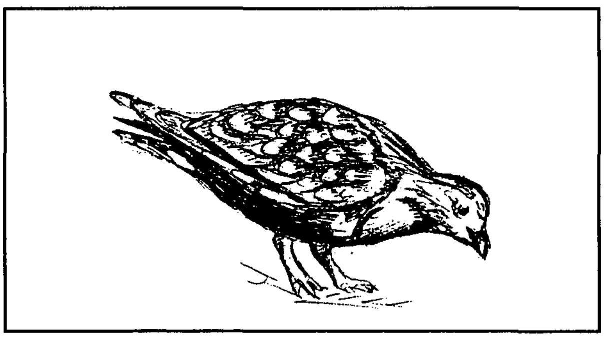
Black-bellied Sandgrouse, *Pterocles orientalis*

Two sandgrouse sterna from the Roman period (H73B.4:97, 63 B.C.-A.D. 130; H74D.295b, A.D. 130-193; pl. 8.5a) probably belong to the black-bellied sandgrouse (fig. 8.28), as their size affirms. This is the largest species of sandgrouse around Tell Hesban. The sterna found are clearly larger than those of the spotted sandgrouse (*Pterocles senegallus*), which was observed near the site by Alomía (1978: 296). Our finds are larger than the sterna of the coronated sandgrouse (*Pterocles coronatus*), the large pin-tailed sandgrouse (*Pterocles alchata*), and the brown-bellied sandgrouse (*Pterocles exustus*) all of which one can expect to find in the vicinity (Hüe and Etchécopar 1970: 366 and pl. 10; Heinzel *et al.* 1972: 166ff.). Pteroclidae sterna differ from those of the closely related Columbidae (dove) family in that the manubrium sterni is missing (pl. 8.5b).

Domestic Pigeon, *Columba livia domestica*
and Rock Dove, *Columba livia*

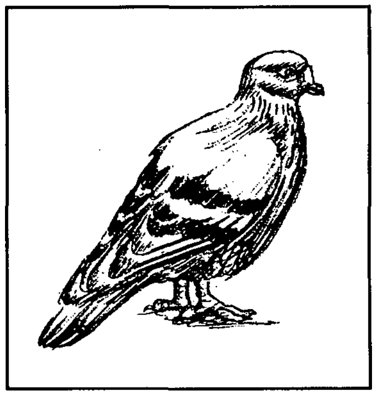
Dove bones are not difficult to identify. Intensive, special comparisons between the dove

Figure 8.28 Black-bellied sandgrouse, *Pterocles orientalis*.



finds and Pteroclidae skeletons are necessary only with the closely related sandgrouse. No further Pteroclidae bones were found during these comparisons. Within the *Columba* genus, identification can cause problems. Domestic pigeons can attain the size of wood pigeons (*Columba palumbus*). The stock dove (*Columba oenas*) is the same size as *Columba livia* (fig. 8.29) and the domestic pigeon, the so-called "Feldflüchter," a fully domesticated pigeon, which depends for its livelihood on man, but must fend for itself.

Figure 8.29 Rock dove, *Columba livia*.



The stock dove, a forest dweller, must be considered a winter guest in the Hesban surroundings (*cf.* Hüe and Etchécopar 1970: 378ff.; Heinzel *et al.* 1972: 170). This was especially true in times when the forest extended farther than it does today. Although we have no chance of identifying them, one or two stock dove bones may be hidden among the adult bone finds. The possible presence of the wood pigeon in the finds—which might also have been a winter visitor (*cf.* Tristram 1884: 119; Bodenheimer 1935: 171)—has been eliminated. The wood pigeon is usually excluded *a priori* on the basis of the trunk and wing bone size, as well as, in some instances, on slight differences in form. We discussed in a previous publication (Boessneck and von den Driesch 1980: 66) how identification based on the femur, tibiotarsus, and tarsometatarsus is difficult because the hind legs of the wood pigeon are only relatively shorter. This is especially troublesome when only the end fragments of the bones are present. Only a few tibiotarsus end fragments created difficulties within the Tell Hesban finds. These problems could be resolved morphologically when compared with a series of skeletons.

It is superfluous to try to distinguish between the domestic pigeon and its wild ancestor, the rock dove (tables 8.8, 8.20-8.22). Both birds form one

Table 8.20 Domestic pigeon and rock dove bone distribution by periods.

Period	Adult/ subadult	Juvenile/ infant	MNI adlt	MNI sub	MNI juv	MNI inf
Mod/undated	10	1	3	-	-	-
Mamluk	57	26	6	1	6	1
Ayyubid	3	1	-	-	1	-
Abbasid	2	-	1	-	-	-
Umayyad	3	-	1	-	-	-
Byzantine	7	-	3	-	-	-
L. Roman	12	2	3	-	1	-1
E. Roman	10	-	1	1	-	-
L. Hellenistic	3	-	1	-	-	-
Total	107	30	19	2	8	2

[1]MNI = minimum number of individuals; adlt = adults; sub = subadults; juv = juveniles; inf = infants

Table 8.21 Domestic pigeon and rock dove bone distribution according to skeletal parts.

Skeletal part	Adult/ subadult	Juvenile/ infant
Neurocranium	1	1
Cervical vertebrae	1	-
Synsacrum	2	-
Sternum	7	1
Coracoid	9	2
Furcula	1	-
Scapula	2	-
Humerus	15	5
Radius	5	-
Ulna	23	8
Carpometacarpus	12	3
Femur	10	4
Tibiotarsus	15	3
Tarsometatarsus	4	3
Total	107	30

community, and a wide spectrum of pigeons ranging from wild to domesticated coexists with human beings. The doves become larger under human husbandry, a fact which offers the possibility of proving domestic pigeon-breeding in ancient Hesban. The size variations which appear throughout the finds, from the rock dove up to the domestic pigeon, negate distinctions between the two species. Small bones might easily come from the domestic pigeon, but the largest cannot come from the rock dove. Most pigeon bones undoubtedly belong to birds which built their nests in houses, thus making the pigeons more or less dependent on their inhabitants. It is conceivable that the site's inhabitants acquired young animals for their meals from these nests.

Nothing can be said concerning the earliest arrival of pigeons at the site or when they were first domesticated. The first dove bones originally appeared to come from the Early Roman period, yet a later dating placed the earliest find (three bones) in the Late Hellenistic period (table 8.20). We are continually finding pigeon bones from this period on, most coming from Mamluk period loci (table 8.20). Several partial skeletons account for the young animal bones accumulated (see below). When the bones are found still joined together and lacking any indication of having been carved for the table, we must ask if these were not young birds which died accidentally, not kitchen remains.

Tables 8.20 and 8.21 are rough overviews which require further interpretation. Seven of the ten bones belong to the same skeleton: a sternum, a left coracoid, a right humerus, a left radius, both ulnae, and a left carpometacarpus. It was a subadult bird which lived during the Early Roman period (H74D.3:57D). Four bones appear to belong together: a right humerus, a right ulna (H76D.3:101), a left ulna, and a right carpometacarpus (H76D.4:101). They come from the Late Roman period (Stratum 13, A.D. 130-193). We were able to analyze only the sternum, synsacrum, and humerus (H71D.6:33, A.D. 1200-1400) of the "nearly whole skeleton" mentioned by LaBianca (1973: 138) as singular proof of the existence of pigeons.

In H71D.6:15 (A.D. 1260-1400), we found a collection of 28 relatively large domestic pigeon bones in good condition, which had previously been identified by Lepiksaar. They represent at least four adult and two young birds. The circumstances surrounding the finds are explained in the computer list as repeated here: "Destruction layer of EMAM occupation and terrace complex." There are no cutmarks or fractures on the bones to indicate their use as table fare.

Five bones from a nestling pigeon (H76G.4:43, A.D. 1200-1400) were preserved: the left half of a neurocranium, a humerus, both ulnae, and a femur. Ten young pigeon bones from H71D.6:10 (A.D. 1400-1456) could be salvaged: a coracoid, two humeri, four ulnae, and three carpometacarpi. The four ulnae belong to three different individuals.

Table 8.22 records information concerning pigeon bone size (*cf.* Fick 1974; Boessneck and von den Driesch 1980: table 38). Some relatively small measurements can be explained by the presence of a small rock dove subspecies (*Columba livia gaddi*) in the Tell Hesban area; not that they came from immature bones.

Table 8.22 Bone measurements for the domestic pigeon, *Columba livia domestica*, and for the rock dove, *Columba livia*.

a) Neurocranium

Loc	A.7:104
Strat	6
LP	32.5
GB	20.5

b) Synsacrum

Loc	D.6:33
Strat	3/4
LV	41.1

c) Sternum

Loc	D.6:33
Strat	3/4
dL	(63)
Lm	62.5
SBF	23.5

d) Coracoid

Loc	B.4:223	D.4:90	C.10:42	D.6:15	A.8:14	C.8:26	A.7:5
Strat	13	13	9	3	2/3	2	1
GL	-	34.4	-	(38.7)	36.7	-	31.8
Lm	-	32.7	31.5	36.7	34.8	(30.5)	30
Bb	14	13.5	-	-	-	-	12.9
BF	10	8.8	-	(11)	(10.8)	-	8.7
				subad	subad		

e) Humerus

Loc	D.1:58A	D.3:101	D.3:57D	A.9:94	D.6:15	C.6:46	D.6:15	D.6:15	C.10:23	C.6:45	C.1:1	C.6:26
Strat	13	13	14	8	3	3	3	3	3	3	2	?
GL	-	45.5	43.5	-	50 50.1	(49)	47.5	46.5	44.1	-	47.2	42
Bp	-	18.3	16.8	-	20 20	-	19.7	19.7	-	-	19.9	-
SC	5.2	4.8	4.5	4.9	5.5 5.6	6	5.7	5.5	5	4.3	5.8	4.9
Bd	10.1	10.6	9.7	10.3	11.8 11.8	-	11.7	11.5	10.5	(10)	11.8	(10)
			subad		subad		subad			subad		

f) Ulna

Loc	B.1:32	D.3:101	C.7:52	D.6:15	D.6:15	D.6:17	C.2:12	A.7:1	A.9:79	C.6:24	A.9:26	A.7:1	?	?1
Strat	15	15	6/8	3	3	3	3	3	3	3	2	1	?	?
GL	(52)	51.6	50.9	61.6	(60) 59.9	56	54.2	50.3	-	-	-	54.1	51.1	-
Bp	(6.5)	(6.8)	6.5	7.5	7.2 7.2	7.5	(7.5)	6.6	-	-	-	7.5	7.1	-
SC	3.6	3.3	3.4	3.6	3.7 3.6	3.8	3.6	3.6	3.3	3.4	3.4	3.8	3.6	-
Did	-	7	7	8	- 7.9	7.7	7.7	6.8	6.8	6.6	6.9	8	7	7
				subad										

g) Radius

Loc	D.3:57D	D.6:15	C.4:30	C.5:91
Strat	14	3	3	3
GL	47	54.6	50.2	46
	subad			

h) Carpometacarpus

Loc	D.3:57D	D.4:101	D.2:43	C.1:11	D.6:15	D.6:15	C.9:36	C.1:4	D.2:15	A.4:1
Strat	14	13	11	6	3	3	3	3	3	1
GL	32.2	32.2	33.4	32	38.8	37.5	33.1	33	31.6	(32)
Bp	8.8	9.3	9.6	9.3	10.5	10.6	9.6	9.5	9.4	9.5
	subad									

i) Femur

Loc	B.1:62	B.4:44	A.3:7	D.6:15	G.11:6	D.6:10	G.4:17	A.10:4
Strat	14	7	14	3	3	2	1	1/2
GL	-	-	39.3	-	(38.7)	44.8	(42)	-
Lm	37.5	-	37	43	(36.5)	43	39.3	-
Bp	(9)	8.2	8.5	9.5	8	9.3	9	-
Dp	(4.7)	(5.2)	4.9	(6)	4.8	(5.6)	5.5	-
SC	3.5	-	3.6	3.6	3.2	3.5	3.8	3.5
Bd	7.5	-	7.6	8.5	-	8.5	8.3	7.5
				subad	subad	subad		

j) Tibiotarsus

Loc	B.3:62	D.6:15	D.6:15	C.4:7	A.7:4	C.4:15	A.7:18	C.2:?
Strat	15	3	3	3	3	3	2	?
GL	(53)	- 62	60.8	-	-	-	-	-
La	(52.5)	- 61.2	60	-	-	-	-	-
Dip	8.5	10 9.8	10.1	-	-	7.8	-	10.5
SC	3.1	- 3.4	3.7	3.6	3.7	-	3	3.6
Bd	-	- 7	7.1	7.8	(7.3)	-	6.1	-
		subad						

k) Tarsometatarsus

Loc	D.6:15	
Strat	3 (belonging together, adult?)	
GL	33.5	33.3
Bp	7.9	7.7
SC	3.3	3.3
Bd	8.7	8.6

As seen in table 8.22d, the two smallest coracoidea and the smallest humerus (measurable only in its distal end) could also have come from the collared turtle dove (*Streptopelia decaocto*), that is, if one evaluated on size comparison alone (*cf.* Fick 1974: 43, 46). A direct comparison, however, shows the coracoidea are too strong, and the humerus too long, to be *Streptopelia*. The identification of the largest bones, most belonging to the H71D.6:15 collection, was made easier because several skeletal parts belong together. Thus, for example, the tibiotarsi and the tarsometatarsi are slimmer than those of the wood pigeon.

Some pigeon bones show cut marks, whereas others have bite marks. Two sterna, H76A.8:2 and H76A.10:12 (pl. 8.5b) are cut transversely. Several humeri were cut off and chewed, both proximally and distally (H71D.6:33, pl. 8.9a). An ulna was carved up crosswise on its proximal and distal ends (H71C.4:19, pl. 8.9b).

Laughing Dove, *Streptopelia senegalensis*

The laughing dove (fig. 8.30), like the rock dove, follows civilization, but prefers to nest in trees rather than houses. The diminutive size of the three bones found prohibits any confusion with the

Figure 8.30 Laughing dove, *Streptopelia senegalensis*.

larger *Streptopelia* species, such as the turtle dove (*Streptopelia turtel*) or the collared turtle dove (*Streptopelia decaocto*). These delicate, trusting doves are usually not hunted. It is not possible to tell if the three fragments are kitchen remains. A bone fragment list follows in table 8.23.

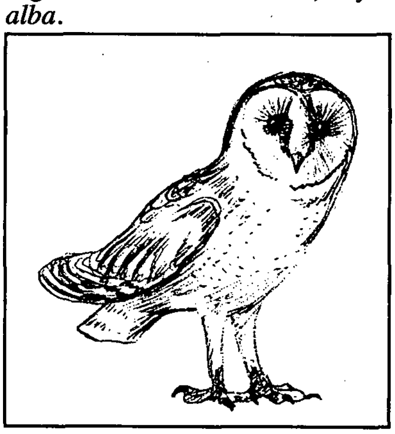
Table 8.23 Bones of the laughing dove, *Streptopelia senegalensis*.

Locus	Dates	Description
H73B.1:139	198-63 B.C.	Humerus, distal half; Bd 7.7.
H76B.2:128	193-63 B.C.	Humerus, left; GL 31.8, Dp 12.7, SC 3.5, Bd (7.7).
H76G.11:6	A.D. 1260-1400	Ulna; GL 37, Bp 5, SC 2.6, Dd 5.

Barn Owl, *Tyto alba*

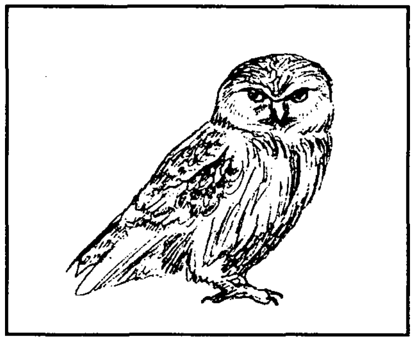
The only barn owl (fig. 8.31) bone was found in the last box to arrive in Munich; a coracoid broken at the sternal margin (H68D.3:10, A.D. 400-451; GL [34.5], Lm [32]). Like the previously discussed species and the following ones, the barn owl lived on the tell itself. It hunted mice deep in the night. From this single find, it is impossible to determine if it was hunted, perhaps due to superstitious beliefs. Even its placement in the Byzantine phase of the city is uncertain.

Figure 8.31 Barn owl, *Tyto alba*.



Little Owl, *Athene noctua lilith*

Figure 8.32 Little owl, *Athene noctua lilith*.



All 21 bones from the little owl (fig. 8.32) came from surface locations, having nothing to do with archaeological finds (table 8.24). These little owls live in the ruins of Tell Hesban and its surrounding area (Alomía 1978: 296). Remains of animals which died within the last century turn up among the archaeological finds. The fact that a number of bones which belong together are found in one location emphasizes this interpretation. In one case, 15 well-preserved bones from one skeleton, were found in two adjacent loci: H74A.9:9 and 10.

Table 8.24 Bones of the little owl, *Athene noctua lilith*.

Locus	Dates	Description
H76F.38:2	700-500 B.C.	Coracoid and scapula.
H76F.38:8	700-500 B.C.	Tarsometatarsus, possibly belonging to the above.
H74A.9:9	A.D. 1400-1976	Left tibiotarsus.
H74A.9:10	A.D. 1400-1976	Cranium, left and right quadratum; mandibula; four sequential thoracic vertebrae; synsacrum and pelvis; sternum; both humeri; radius; both ulnae; right femur; left tarsometatarsus.
H68D.1:1	A.D. 1400-1976	Occipital bone.
H73A.7:5	A.D. 1870-1976	Right humerus without caput and proximal part of corresponding right ulna.

Although not in itself of archaeological significance, the measurements listed in table 8.25 are of zoological interest, since there are no available measurements for the subspecies *Athene noctua lilith*.

Table 8.25 Bone measurements of the little owl, *Athene noctua lilith*.

a) Upper Skull

Loc	A.9:10
Strat	1/2
GL	49.5
LP	35.8
L1	17.7
GB	38.5

b) Mandibula

Loc	A.9:10
Strat	1/2
GL	33.5

c) Sternum

Loc	A.9:10
Strat	1/2
LM	28.5
dL	28

d) Coracoid

Loc	F.38.2
Strat	16
GL	27.2
LM	26.6
Bb	8.5
BF	7.2

e) Humerus

Loc	A.9:10		A.7:5
Strat	1/2		1
GL	49.9	-	-
Bp	10.2	10.1	-
SC	3.4	3.4	3.6
Bd	9	-	8.8

f) Radius

Loc	A.9:10
Strat	1/2
GL	57.7

g) Ulna

Loc	A.9:10		A.7:5
Strat	1/2		1
GL	60.1	60	-
Bp	5.7	5.8	5.7
SC	2.7	2.7	-
Did	5.2	5.2	-

h) Pelvis

Loc	A.9:10
Strat	1/2
GL	36.3
CB	15.7
BA	19.3
SB	11.2
LV	24.9

i) Femur

Loc	A.9:10
Strat	1/2
GL	38.3
Lm	36.5
Bp	7.6
Dp	4.6
SC	3.3
Bd	7.3

j) Tibiotarsus

Loc	A.9:9
Strat	1/2
GL	55.6
La	55
Dp	8.1
SC	3
Bd	6.8

k) Tarsometatarsus

Loc	A.9:10	F.38:8
Strat	1/2	16
GL	32.8	31.8
Bp	7	7
SC	3.6	3.1
Bd	7.4	6.8

Short-toed Lark, *Calandrella brachydactyla* or Lesser Short-toed Lark, *Calandrella rufescens*

The small lark's sternum (H74G.10:8) mentioned in the preliminary report fits our short-toed lark's (fig. 8.33) skeleton. Since the initial report, we have realized that the bone's presence is due to a modern disturbance of the find site. We do not have a skeleton from the lesser short-toed lark (fig. 8.34), which is less likely to be found around Tell Hesban. Alomía reports: "The Short-toed Lark (*Calandrella cinerea*) appeared in flocks at Hesbân, such as we saw on 28 July at the southeast side of the hill on the Wadi el-Marbat" (1978: 298). The stone lark (*Ammomanes deserti*), a bird similar in size which we observed, has a short rostrum sterni bent upwards.

Figure 8.33 Short-toed lark, *Calandrella brachydactyla*.

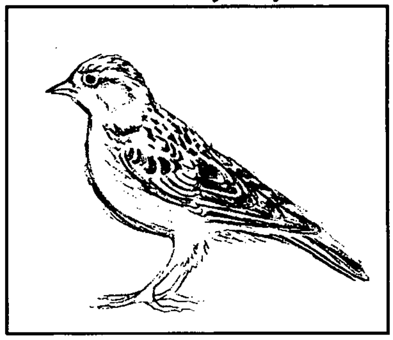
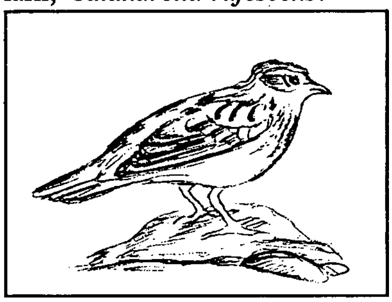


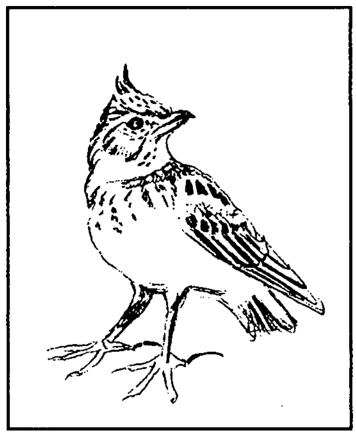
Figure 8.34 Lesser short-toed lark, *Calandrella rufescens*.



Crested Lark, *Galerida cristada* or Skylark, *Alauda arvensis*

"The Crested Lark is one of the most common birds throughout the cultivated parts of Palestine" (Bodenheimer 1935: 159) and breeds in the Hesban area (Alomía 1978: 298). The most convincing evidence from our finds favoring the crested lark (fig. 8.35) identification is a sternum (H76F.38:8, Modern); however, it could have come from a skylark (fig. 8.36), especially if we compare its Lm of 28.7 with 28.6 for the crested lark and for skylarks: 25.8-29.9, $\bar{x}=28.4$, $S=1.46$ ($n=6$). Two humeri and one femur match the size of the skylark, which is not only a winter guest but also found in summer, much better than those of the crested lark (table 8.26).

Figure 8.35 Crested lark, *Galerida cristada*.



Plates 8.10-8.17 **10) Tortoise**, *Testudo graeca terrestris*: H76C.1:134; fourth of a hypoplastron drilled through post mortem; **11a, b) tortoise**, *Testudo graeca terrestris*: H74E.4:7; high curved back shell; **12) Isabelline wheatear**, *Oenanthe isabellina*: H76C.1:124; humerus, GL 20.7; **13) doubtful rock sparrow**, *Petronia petronia*: H76C.9:22; humerus, GL 22.7; **14a) rock sparrow**, *Petronia petronia*: H76C.9:37; upper bill; **14b) doubtful house sparrow**, *Passer domesticus*: H71D.6:4; upper skull, GL 30.3; **15) woodlark**, *Lullula arborea*: H74G.10:7; upper skull, GL 30.5; **16a) hardoun**, *Agama stellio*: H73F.16:6; upper jaw; **16b) hardoun**, *Agama stellio*: H71D.6:4; lower jaw, GL 34.6; **17) racer**, *Coluber spec*: H76C.5:161; lower jaw, GL 35.7.

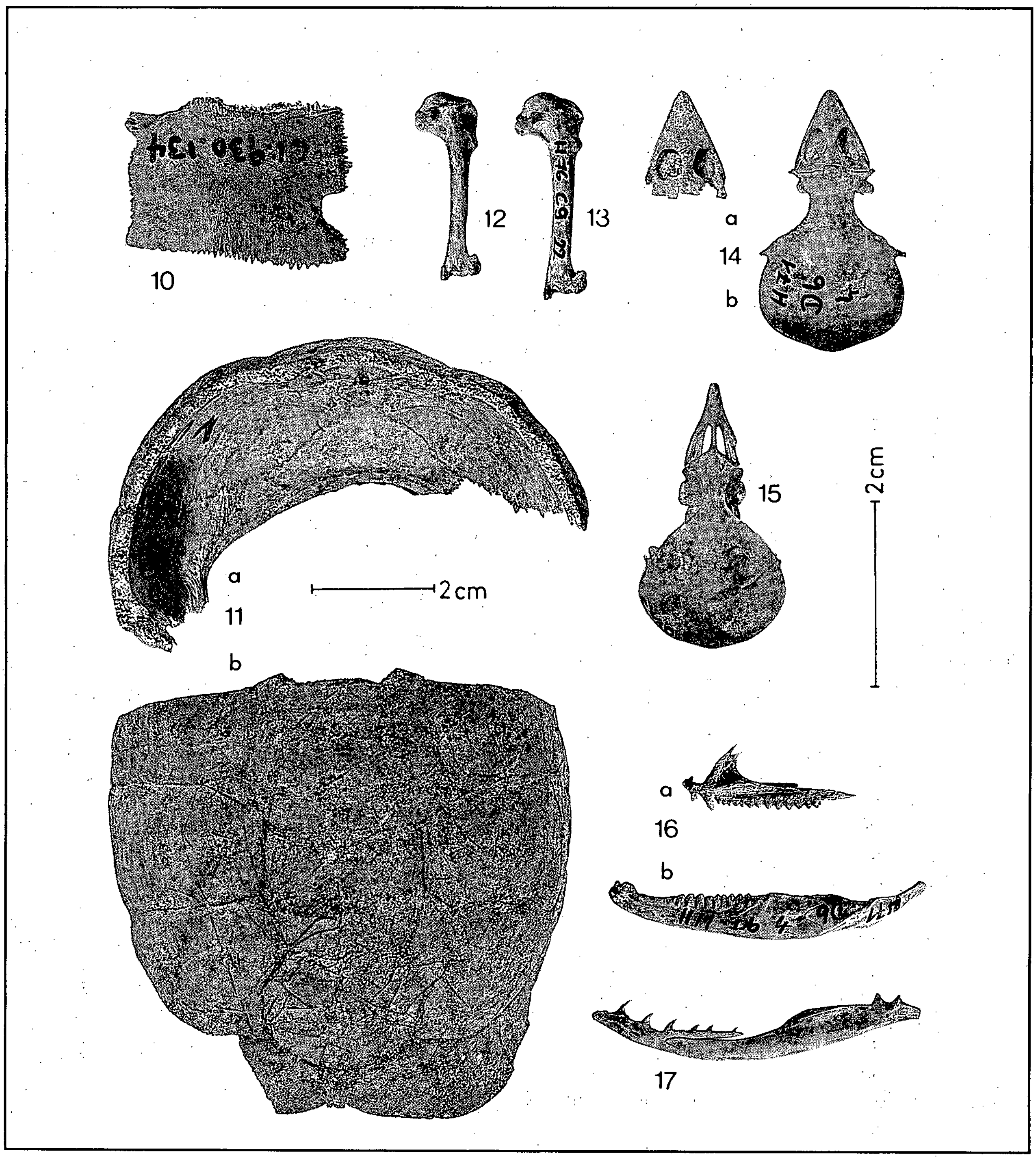
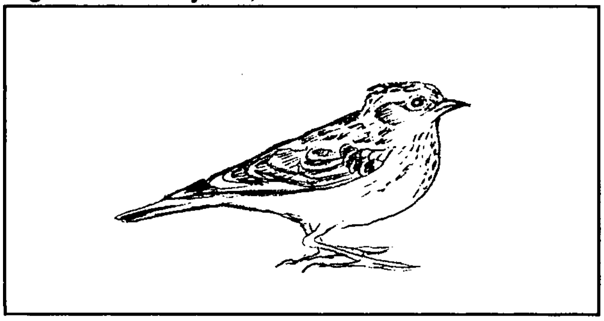


Figure 8.36 Skylark, *Alauda arvensis*.



Recent comparative materials give the following measurements: crested lark: humerus (GL 27) and femur (GL 20.6); skylark: humeri (GL 24.4-27.4), $\bar{x}=26.6$, $S=0.95$ [n=7]) and femora (GL 18.8-21.6, $\bar{x}=20.0$, $S=0.89$ [n=8]).

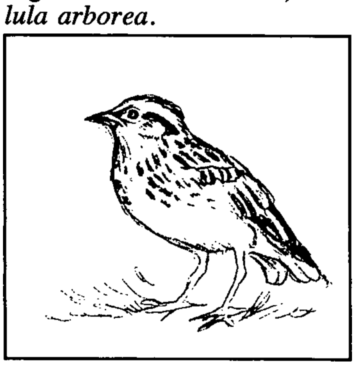
Table 8.26 Bones of the crested lark, *Galerida cristada*, or skylark, *Alauda arvensis*.

Locus	Dates	Description
H73B.1:136	198-63 B.C.	Humerus; GL 25.6, Bp 7.1, SC 2.3, Bd 5 (minus spur).
H73D.4:13	A.D. 1260-1400	Humerus; GL 25.7, Bp (7), SC (2.4), Bd 5.1 (minus spur).
H76F.38:8	A.D. 1870-1976	Femur; GL 19, Lm 18.3, Bp 2.9, SC 1.4, Bd 3.

Woodlark, *Lullula arborea*

As with most of the other songbird bones, the upper skull from the woodlark (fig. 8.37) does not come from ancient times, nor does it represent a cultural product. It was found in the soil which filled a grave (H74G.10:7). The skull (pl. 8.15) has the following measurements: GL 30.5, CBL 26.3, LP 19.3, Ll 12, GB 15.8, and GH 12.2. The skull size alone could be identified either with that of the short-toed lark or stone lark. Skull morphology, however, prohibits these identifications. The narrower and more deeply indented forehead-bonebridge, located between the orbitae, is typical of the woodlark which is among Palestine's common winter guests (Bodenheimer 1935: 159). Tristram reports, "The Woodlark remains all the year in the country" (1884: 79).

Figure 8.37 Woodlark, *Lullula arborea*.



Warbler, *Hippolais* Species

An ulna (H74 D.2:95B, A.D. 130-193; GL 18.8), while having measurements that correspond to the icterine warbler (*Hippolais icterina*; fig. 8.38), more likely belongs to the olivaceous warbler (*Hippolais pallida*; fig. 8.39), although we do not have any comparative material from this spècies to verify the identification. Furthermore, the olivaceous warbler commonly breeds in this area; whereas the icterine warbler is migratory. We cannot exclude the possibility of it belonging to the thorn warbler (*Hippolais languida*; fig. 8.40), which also breeds in this area; but the olive-tree warbler (*Hippolais*

Figure 8.38 Icterine warbler, *Hippolais icterina*.

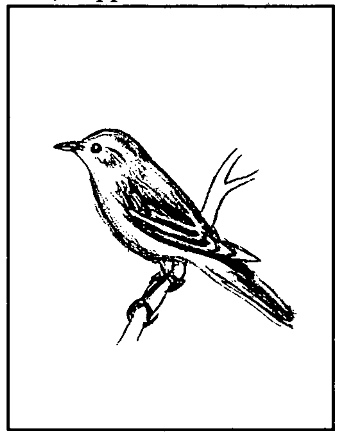


Figure 8.39 Olivaceous warbler, *Hippolais pallida*.

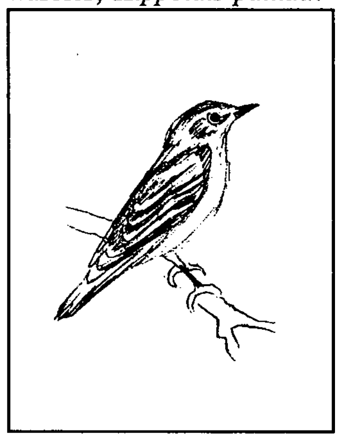


Figure 8.40 Thorn warbler, *Hippolais languida*.

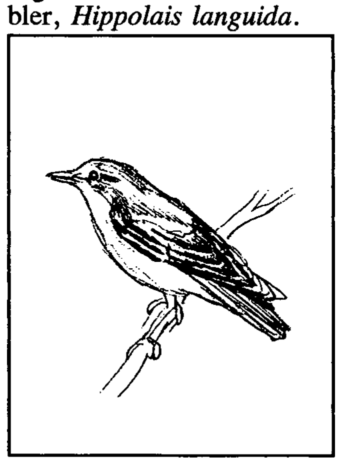


Table 8.27 Bones of the wheatear, *Oenanthe* species.

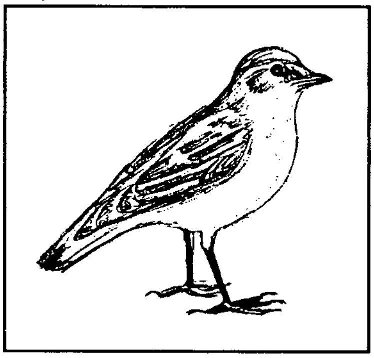
Locus	Dates	Description
H74C.1:124	A.D. 130-193	Humerus (pl. 8.12).
H76F.30:3	A.D. 1260-1400	Two tibiotarsus halves, both from the same side.
H76F.38:8	A.D. 1870-1976	Humerus with proximial and distal ends bitten off.

olivetorum) can be ruled out on account of its being too large.

Wheatear, *Oenanthe* Species

The final species identification of four *Oenanthe* bird bones presents problems, because there are at least eight wheatear species in the Hesban surroundings (Heinzel *et al.* 1972: 244ff.). The bones are described in table 8.27.

Figure 8.41 Isabelline wheatear, *Oenanthe isabellina*.



The size of two humeri corresponds best to the Isabelline wheatear (*Oenanthe isabellina*; fig. 8.41). In table 8:28, we present comparative measurements taken from the humeri of the two largest individuals in our recent comparative material. In addition, we give the measurements of the two biggest males

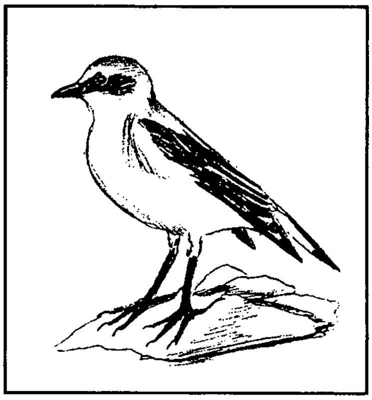
Table 8.28 Measures of two male wheatear humeri from Tell Hesban compared with male wheatear humeri from the authors' collection.

	Hesban		*O. isabellina*		*O. oenanthe*	
Loc	C.1:124	F.38:8	Male?	Male?	Male	Male
GL	20.7	-	20.8	20.8	19.7	19.2
Bp	6.5	-	6.4	6.7	6.1	6.1
SC	2.0	2.0	2.0	1.9	1.8	1.9
Bd*	4.8	-	4.8	4.8	4.5	4.6

* Bd is measured without the Processual supracondylicus radialis

from the common wheatear (*Oenanthe oenanthe*) in our collection.

Figure 8.42 Black-eared wheatear, *Oenanthe hispanica*.

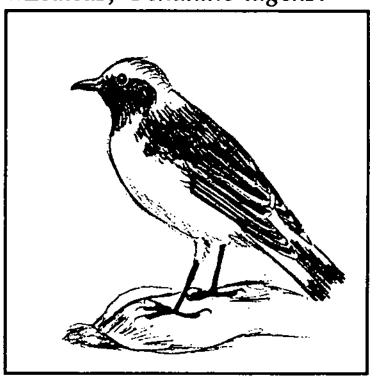


Females of both species are smaller than males. The common wheatear was selected for comparison, because most of the probable *Oenanthe* species are either its equal in size or smaller (Heinzel *et al.* 1972: 244 ff). We have no comparative measurements for some of these species.

The fact that the Isabelline wheatear breeds on Tell Hesban (Alomía 1978: 298) aids in identifying the finds as belonging to this species. The equally-sized, but rare, red-rumped wheatear (*Oenanthe moesta*) could be observed by Alomía only in the wider Hesban surroundings, primarily on the slopes of the Wadi el-Majarr and the Wadi Hesban.

Alomía, as well as Boessneck and von den Driesch observed the black-eared wheatear (*Oenanthe hispanica*; fig. 8.42) and the mourning wheatear (*Oenanthe lugens*; fig. 8.43) in the immediate Hesban locale. Both species are too small, however, to be compared with the humerus finds. Nevertheless we must take both species into consideration when attempting to identify the two tibiotarsi finds, both of which have a Bd of 2.7. These measurements indicate that the bones are too weak to be identified with the Isabelline wheatear, whose tibiotarsus measures about 3 mm. Without verifiable data, the final identification of these two bones must remain uncertain.

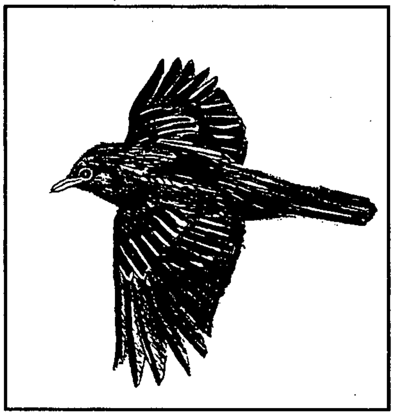
Figure 8.43 Mourning wheatear, *Oenanthe lugens*.



European Blackbird, *Turdus merula*

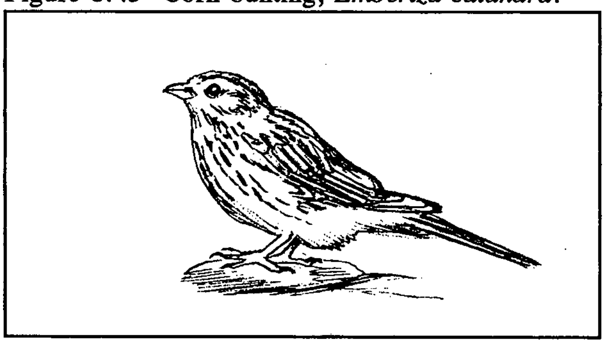
The European blackbird (fig. 8.44) vanished from the

Figure 8.44 European blackbird, *Turdus merula*.



Hesban surroundings at the time of deforestation. Of the two blackbird bones mentioned in the preliminary report, only a lower jaw from F.30:3 remains positively identified. The initial dating of this find to the Early Byzantine period was discarded during work on the date-identification. However, the new proposed dating of A.D. 1240-1400 is also unacceptable. The description concerning the original discovery (soil fill in tombshaft and arcosolia) makes it probable that the bones cannot be dated.

Figure 8.45 Corn bunting, *Emberiza calandra*.



Corn Bunting, *Emberiza calandra*

Two bunting bones are too large to include the yellowhammer (*Emberiza citrinella*) and other buntings of this size. Yet when they are compared to our incomplete collection of comparative material we find them to be small for a corn bunting (fig. 8.45). The bones, however, match this species much better than those of any other bunting (table 8.29).

Table 8.29 Bones of the corn bunting, *Emberiza calandra*.

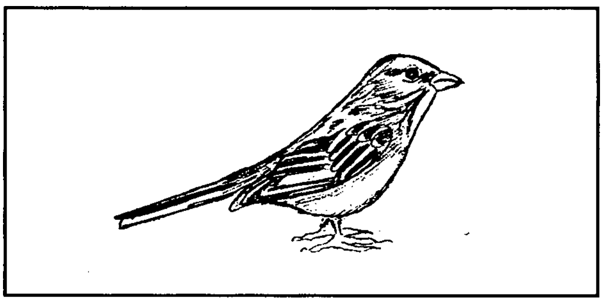
Locus	Dates	Description
H76C.9:37	A.D. 1400-1456	Carpometacarpus; GL 16.1.
H76F.38:2	A.D. 1870-1976	Ulna; GL 27.6.

Table 8.30 Bones of the medium-sized bunting, *Emberiza* species.

Locus	Dates	Description
H76C.1:133	1150-900 B.C.?	Humerus; GL 19.3, Bp (6.2), SC 1.8, Bd 4.5 (minus spur).
H76F.38:8	A.D. 1870-1976	Tibiotarsus without proximal ends, right and left side; SC 1.3,

As has been mentioned in the preliminary report, the carpometacarpus was identified by J. Lepiksaar. The location of the find suggests, as a more probable bone identification, the rock sparrow. The corn bunting probably breeds in the Hesban surroundings. At the least, it commonly visits during the winter.

Figure 8.46 Ortolan bunting, *Emberiza hortulana*.



Medium-sized Bunting, *Emberiza* species

The three bunting bones in table 8.30 cannot be identified as to species. The humerus is smaller than the one from the only ortolan bunting female skeleton we have (*Emberiza hortulana*; fig. 8.46). The ortolan humerus, measuring GL 20.0, Bp 6.5,

Figure 8.47 Grey ortolan, *Emberiza caesia*.

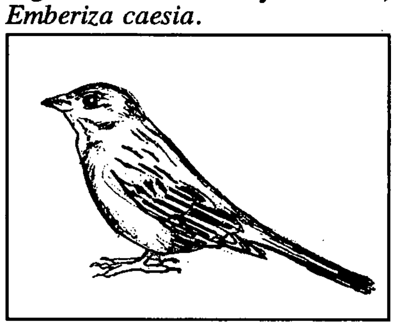
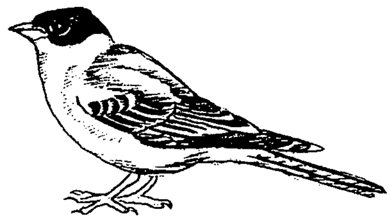


Figure 8.48 Black-headed bunting, *Emberiza melano-cephala*.



SC 1.7, and Bd 4.7 (minus spur), is from a female individual. The grey ortolan (*Emberiza caesia*; fig. 8.47) should fit. The black-headed bunting (*Emberiza melano-cephala*; fig. 8.48) skeleton in our collection, a male, is larger: GL 20.2, Bp 6.4, SC 1.8, and Bd 4.9 (minus spur). The tibiotarsi lengths correspond better to the ortolan (GL 28.8, SC 1.3, Bd 2.5) while the black-headed bunting has longer and slimmer hind legs. Its tibiotarsus measures GL 32.7, SC 1.2, and Bd 2.7.

Although all these species, including the black-headed bunting, breed in Palestine (Hüe and Etchécopar 1970: 853ff.), the most common is the ortolan, which we observed several times during our short stay at Tell Hesban.

House Sparrow, *Passer domesticus*

Two house sparrow (fig. 8.49) upper skulls come from H71D.6:4. One of these has fallen to pieces. We were able to take the following measures from the other one: GL 30.3, LP 19, Ll 13, GB 15.5, and GH 12 (pl. 8.14b). The dating of the two finds to A.D. 1400-1456 (Stratum 2) is questionable.

In H71D.5:5D, along with other bones representing songbirds (*e.g.*, a carpometacarpus from a starling), three humeri were salvaged. They appear to represent two subadult house sparrows

Figure 8.49 House sparrow, *Passer domesticus*.

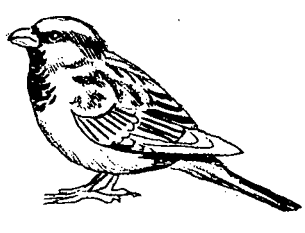


Table 8.31 Measurements of three house sparrow, *Passer domesticus*, humeri from H71D.5:5D.

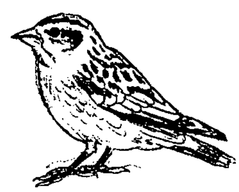
	Measurement		
GL	19.0	17.6	17.5
Bp	6.2	6.0	5.8
SC	1.7	1.6	1.5

(compare Boessneck and von den Driesch 1979a: 360). The three humeri measurements are presented in table 8.31.

A synsacrum with two pelvis halves represents an adult house sparrow (D.5:5D, LV 14.3, LS 17.5). Since we do not have any comparative material from the rock sparrow (*Petronia petronia*), we cannot rule out this species either. The dating of these bones to A.D. 1260-1400 (Stratum 3) also cannot be viewed as conclusive.

Rock Sparrow, *Petronia petronia*

Figure 8.50 Rock sparrow, *Petronia petronia*.



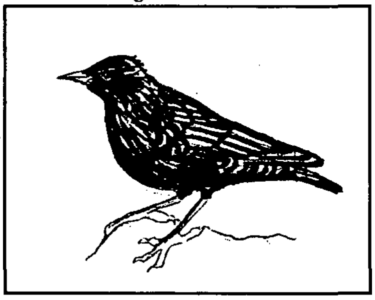
Even without comparative material, an upper bill, together with the interorbital bridge (H76C.9:37; pl. 8.14a) and corresponding lower jaw (H76C.9:22), can be identified as belonging to a rock sparrow (fig. 8.50), a bird common to Tell Hesban. The identification of three additional bones, however, all belonging together, remains doubtful (table 8.32).

The bone measurements are smaller than those

Table 8.32 Bones which may belong to the rock sparrow, *Petronia petronia*.

Locus	Dates	Description
H76C.9:22	A.D. 1400-1456	Humerus from right side; GL 22.7, Bp 7.5, SC 2.2, and Bd 5.1 (without spur) (pl. 8.13).
H76C.9:22	A.D. 1400-1456	Ulna from right side; GL (27.5).
H76C.9:37	A.D. 1400-1456	Humerus from left side; GL 22.6, Bp 7.6, SC 2.2, and Bd 5.0 (without spur).

Figure 8.51 Common starling, *Sturnus vulgaris*.



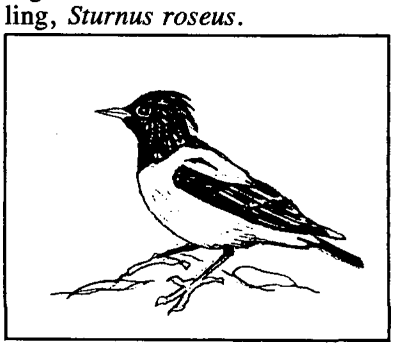
from the corn bunting but larger than the house sparrow. The rock sparrow and the house sparrow are equal in length, but only because the former has a shorter tail. Its wingspan is much wider than that of the house sparrow (*cf.* Wüst 1970: 437, 441), which leads us to expect larger wing bones. Thus considered, the bones were identified as belonging to the rock sparrow. The A.D. 1400-1456 dating for these finds is as much in doubt as it is for those of the other songbirds.

Common Starling, *Sturnus vulgaris*
or Rose-colored Starling, *Sturnus roseus*

The starling bones form the largest group of remains from songbirds in the Tell Hesban finds. The common starling (fig. 8.51), although found in winter in large numbers in Palestine, is migratory and does not breed in this country. The rose-colored starling (fig. 8.52) "is very erratic in its visits. This Central Asiatic bird sometimes follows the locust invasions in considerable numbers and is spoken of as the locust-bird" (Bodenheimer 1935: 155; *cf.* Tristram 1884: 73). With the possible exception of the skull, the skeletons of these two birds are indistinguishable from each other; however, the bones represented are most certainly from the common starling.

A single bone represents a find from the Late Hellenistic period. All other finds represent either the Mamluk or Modern periods. A list follows in table 8.33.

Figure 8.52 Rose-colored starling, *Sturnus roseus*.



Almost all the bones are well preserved and do not appear to be table scraps. The conglomerate of 18 bones, most of which are intact, supports the opinion that they are not kitchen debris. Starling flesh is reportedly bad tasting (von Strassen 1925: 309), and is poorly digestible (Keller 1913: 91). Table 8.34 presents bone size comparisons (*cf.* Boessneck and von den Driesch 1979a: table 161).

Table 8.33 Bones of the common starling, *Sturnus vulgaris*.

Locus	Dates	Description
H68B.1:45	198-63 B.C.	Tarsometatarsus.
H71D.5:5D	A.D. 1260-1400	Carpometacarpus.
H74C.7:1	A.D. 1400-1456	Humerus.
H76C.9:37	A.D. 1400-1456	Synsacrum-fragment.
H76G.4:26	A.D. 1400-1456	Pelvis, half from the right side, synsacrum with right half of pelvis; tibiotarsus; MNI=2.
H76G.11:1	A.D. 1400-1456	Tarsometatarsus.
H68D.2:1	A.D. 1400-1976	Synsacrum; two sterna, coracoid, right and left side; two humeri, right; proximal half of left humerus; two left radii, right and left femur; two tibiotarsi from right side; two tibiotarsi from left side; two tibiotarsi, one from right side and one from left side; MNI=2.
H68D.2:1	A.D. 1870-1976	Tibiotarsus.
H76F.30:3	A.D. 1260-1400?	Humerus.
H76G.4:22	A.D. 1870-1976	Coracoid, right and left.

Jackdaw, *Corvus monedula soemmeringii*

"The Jackdaw is a common winter guest in the area around Hesban. Its breeding area, however, begins already in Northern Palestine: it could have bred in former times as well south of Hesban" (Boessneck and von den Driesch 1981: 67; 1978: 279; *cf.* Hüe and Etchécopar 1970: 524; Heinzel *et al.* 1972: 310). One of the three confirmed jackdaw bones, a femur, belonged to a bird that had just learned to fly.

Jackdaws (fig. 8.53), as well as the crows discussed in the following paragraphs, search

Figure 8.53 Jackdaw, *Corvus monedula soemmeringii*.

Table 8.34 Bone measurements of the common starling, *Sturnus vulgaris*.

a) Synsacrum

Loc	G.4:26	D.1:1
Strat	2	1/2
LV	24.5	24

b) Sternum

Loc	D.1:1
Strat	1/2
Lm	33

c) Coracoid

Loc	D.1:1	G.4:22	
Strat	1/2	1	
GL	26.2	26	25.7
Lm	25	25.2	25

d) Humerus

Loc	F.30:3	C.7:1	D.1:1	D.1:1	D.1:1
Strat	18	2	1/2	1/2	1/2
GL	28.2	28	28.6	28.6	-
Bp	-	8.7	9	-	8.8
SC	2.8	2.7	2.7	2.7	-
Bd w/o ps	6.2	6.3	6.4	6.4	-
Side	R	L	R	R	L

e) Carpometacarpus

Loc	D.5:5D
Strat	3
GL	20.8
Bp	4.8

f) Femur

Loc	D.1:1	D.1:1
Strat	1/2	1/2
GL	26.4	26.4
Lm	25.5	25.3
Bp	4.5	5
Dp	2.7	2.8
SC	2.1	2
Bd	4.5	4.5
Side	L	R

g) Tibiotarsus

Loc	G.4:26	D.1:1		D.1:1		D.2:1
Strat	2	1/2		1		1
GL	46.8	(47.5)	47.3	-	46.3	46.2
La	45.7	-	46.2	45.5	45.4	45.5
Dip	6.4	6.4	6.3	(6)	6	6.4
SC	2	1.8	1.8	1.8	1.8	1.9
Bd	4	4	4	4	4	3.9
Side	R	L	R	L	R	R

h) Tarsometatarsus

Loc	B.1:45	G.11:1	D.1:1	
Strat	15	2	1/2	
GL	30.2	29.7	32.2	32.3
Bp	4.2	4.4	4.5	4.5
SC	1.6	1.6	1.7	1.7
Bd	3.3	3.3	3.4	3.4

for food in the debris and fields surrounding Tell Hesban.

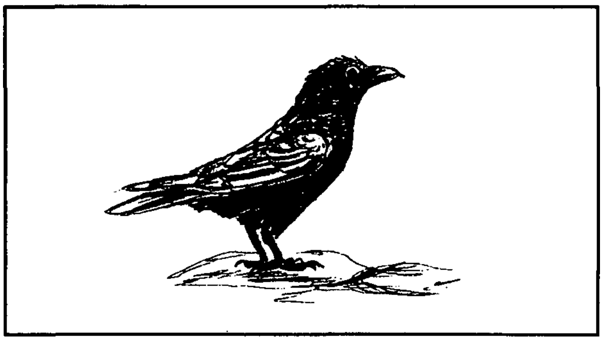
Brown-necked Raven, *Corvus ruficollis*

In addition to the hooded crow (*Corvus corone sardonius*), three crow species are expected to be represented in the Tell Hesban finds: the common raven (*Corvus corax*), the fan-tailed raven (*Corvus rhipidurus*), and the desert raven or brown-necked raven (*Corvus ruficollis*; fig. 8.54) (*cf.* Alomía 1978: 299). The smallest of these species is the brown-necked raven, which replaces the common raven in the dry areas south and east of Tell Hesban (Hüe and Etchécopar 1970: 514, map).

Table 8.35 Bones of the jackdaw, *Corvus monedula soemmeringii*.

Locus	Dates	Description
H74D.3:57C	63 B.C.-A.D. 130	Femur, immature; GL 38, SC 3.2.
H76A.9:97	A.D. 551-614	Ulna, subadult; GL 57, Bp 6.7, SC 3, Did 7.
H76C.8:18	A.D. 1260-1400	Carpometacarpus; GL 38, Bp 8.4 (pl. 8.8).

Figure 8.54 Brown-necked raven, *Corvus ruficollis*.



As previously mentioned, it was more difficult to distinguish between the hooded crow and the brown-necked raven in the Tell Hesban finds than between the brown-necked raven and the common raven. The reason for this is that there are two hooded crow subspecies: *Corvus corone sardonis* in the South, and *Corvus corone cornix* in the North. If it is true that the former is not so large as its northern counterpart, then the smaller ulna from B.1:103 (LaBianca 1973: 134, 140), which was first identified as hooded crow, can only be identified as the brown-necked raven. This fact has been discussed previously (Boessneck and von den Driesch 1978: 278ff. and pl. 23.19; Boessneck and von den Driesch 1981: 67).

Meinertzhagen (1930: 94) reports the wingspan of the hooded crow in Egypt to be between 286 and 332 mm (n=50). That of *Corvus corone cornix* extends up to 340 mm. Hüe and Etchécopar (1970: 521) report a corresponding wingspan of 320-340 mm. In contrast, brown-necked ravens vary in wingspan between 355-420 mm (n=35; Meinertz--hagen 1930: 91).

The volume of so much recent and subfossil comparative material from *Corvus corone cornix* (*cf.* Boessneck and von den Driesch 1979a: 352) justifies the statement that the estimated length of the ulna from B.1:103 exceeds the greatest possible length we might expect from that species. In our recent comparative material we found the greatest possible length for cornix to be 87 mm. The ulna

Plates 8.18-8.21 **18) Ostrich,** *Struthio camelus syriacus*: H71A.6:18; Phalanx 1 III posterior, GL (92); **19a) Scheltopusik,** *Ophisaurus apodus*: Os parietale, GL 32.8; **19b) Scheltopusik,** *Ophisaurus apodus*: Maxillare, teeth-row length 23.5; **19c) Scheltopusik,** *Ophisaurus apodus*: Dentale, teeth-row length 28; **20a) Houbara bustard,** *Chlamydotis undulata*: H71D.6:33; femora: male; **20b) Houbara bustard,** *Chlamydotis undulata*: H71D.6:33; femora: female; **21a) common raven,** *Corvus corax subcorax*: H71D.5:5; ulna without distal end; **21b) brown-necked raven,** *Corvus ruficollis*: H68C.2:9, ulna; **21c) brown-necked raven,** *Corvus ruficollis*: H71B.1:103, ulna.

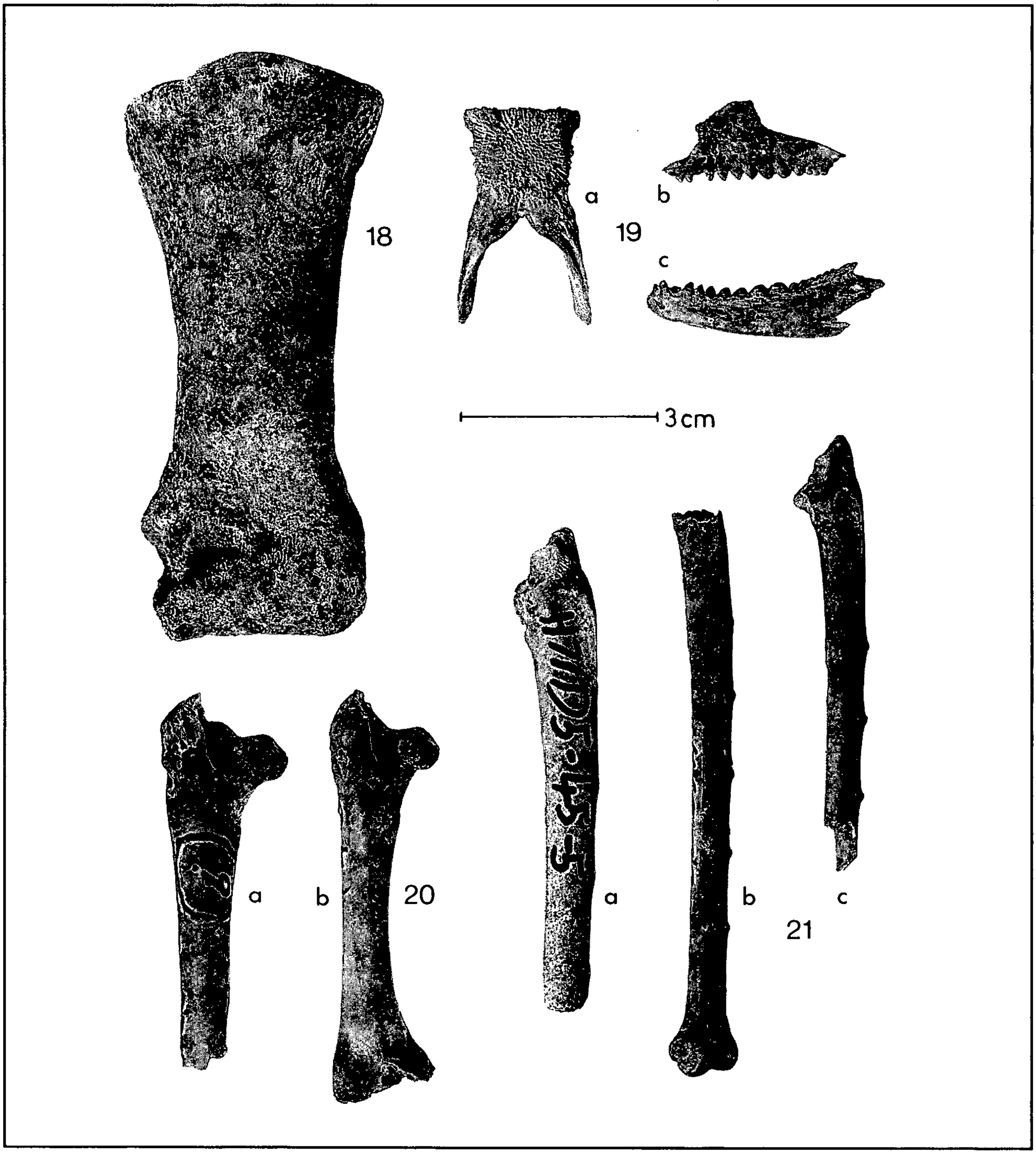
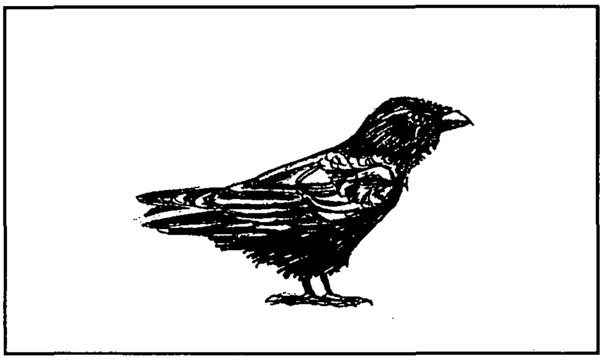


Figure 8.55 Common raven, *Corvus corax subcorax*.



from Tell Hesban exceeds the estimated GL 90 by 5 mm, making the actual length 95 by comparison (pl. 8.21c). Two additional ulnae, an undatable find (H68C.2:9) later added to the collection and a find from the German excavations at Elephantine in Upper Egypt, present further illustrations for the greatest possible bone lengths. The Egyptian find has a total length of 97.5 mm and is almost as slim as the find from H71B.1:103, which is dated as Early Roman (63 B.C.-A.D. 130). The H68C.2:9 ulna is stronger and longer (pl. 8.21b), although its proximal end has been bitten off. The total bone length of approximately 100 mm would be abnormally small if it had come from a common raven. One can, therefore, say without hesitation that the bone represents the brown-necked raven. This ulna from C.2:9 has a Did of 14.5 and a SC of 5.5, while the B.1:103 ulna has a SC of 4.6 and a Bp of 11.5. Since we neither have any comparative material from the fan-tailed raven nor the brown-necked raven, we must consider both a possibility. The fan-tailed raven is stronger than the brown-necked raven.

A third bone which, according to its size, can be identified as belonging to the brown-necked raven is a scapula from H71A.6:20 (A.D. 1260-1400). It is too large to be hooded crow, but too small to represent the common raven.

Common Raven, *Corvus corax subcorax*

The Near Eastern subspecies *Corvus corax subcorax* (fig. 8.55) is larger than the nominate species *Corvus corax corax* (Hüe and Etchécopar 1970: 514ff.), which helped in the identification process. A mandible from F.38:91 excludes the fan-tailed raven because of its shape. The following finds were recorded (table 8.36).

Table 8.36 Bones of the common raven, *Corvus corax subcorax*.

Locus	Dates	Description
H74B.7:10	A.D. 1260-1400	Carpometacarpus; GL 73.5, Bp 16.7.
H71D.5:5	A.D. 1260-1400	Synsacrum and Pelvis; proximal, half of a right ulna (pl. 8.21a), Bp (14); distal half of a left ulna, Did 13.5; proximal three-fourths of a tibiotarsus, right and left Dip 19.7 and 19.6, SC 5.8 from one individual.
H76F.38:9	Modern	Mandible; humerus corpus and femur corpus, both bitten off. Probably one individual.
H71A.6:1	1870-1976	Coracoid, leached-out.

This last bone is added as the tenth to the already mentioned nine finds in the preliminary report.

Unidentified Birdbones

Except for nine fragments of unidentified, medium-sized and larger bird bones, there are eight nestling bones from C.9:22, corresponding in size to that of doves. One humerus and a tibiotarsus from F.38:8 belong to an unidentified infantile songbird. A tibiotarsus from H71D.5:5D (GL 30.5, SC 1.4, Bd [2.5]) is too big to be a house sparrow, to which this bone ought to belong, according to the other bones. It is also too wide to be a bunting. As in the case of the rock sparrow, the lack of comparative material allows no more discussion. The case is the same with the tarsometatarsus which has the following measures: GL 20.3, Bp 3.2, SC 1.1, and Bd 2.4.

Reptiles and Amphibians

Tortoise, *Testudo graeca terrestris*

As was communicated in the preliminary report, tortoise bones are found in almost all levels (table 8.37). Most of them are in such fragmentary condition that one could conclude them to be table scraps. Like other bone refuse, most of the time only single or several rather small fragments are found in one place, although afterwards some of

Table 8.37 Distribution of land turtle bones by period.

Period	Date	Number of bones: Carapace	Skeletal Parts	MNI: adlt	juv	inf
Mod/undated	-	21	3	3	3	1
Mamluk	A.D. 1260-1456	26+2 skel	6	8~	-	2
Ayyubid	A.D. 1200-1260	1	-	1	-	-
Abbasid	A.D. 750-969	3	-	1	-	1
Umayyad	A.D. 661-750	2	1	1	1	-
Byzantine	A.D. 400-614	3	1	3	-	-
L. Roman	A.D. 130-365	2	2	2	1	-
E. Roman	63 B.C.-A.D. 130	3	1	-	2	-
L. Hellenistic	198-63 B.C.	8+1 skel	1	4~	-	-
Iron	1150-8th c. B.C.	4	3	-	2	-
Total		73+3 skel	18	total MNI = 36		

these pieces could be fitted together at the sutures and thus counted as a single bone. Often, however, the pieces are broken apart, not at the sutures but cracked or smashed to pieces, right through the plates. To suggest that turtle meat was consumed is in no way out of place, as Boessneck and von den Driesch discussed in their paper analyzing the Neolithic finds from Fikirtepe near Istanbul (1979b: 50).

Besides the individual pieces, there are three almost complete, though to a large extent crumbled tortoise skeletons, from loci B.2:135 (198-35 B.C.), G.4:11 (A.D. 1400-1456), and G.12:3 (A.D. 1200-1400), for which the cultural classification and dating is questionable. Tortoises bury themselves or crawl into the burrows of other animals or hollows. The three skeletons were not mentioned in the excavation reports (see Blaine 1978; Sauer 1978; Wimmer 1978), although the individual pieces were carefully collected. Especially with the find from Sounding G.4, it appears that the animal whose skeleton we have, crawled into the cave (G.4:2). Perhaps he could not get back out and died there. Or perhaps he was beaten to death, because the shell shows traces of a wound. Since pieces are missing, it cannot be completely reconstructed. The animal could also have entered the hole in the Post-Mamluk period, if it was not closed up. In recent times, Cave G.4:2 was used "for storing straw and firewood, and as a shelter for animals, particularly sheep and goats" (Wimmer 1978: 151 and pl. 24.B). The tortoise from G.12:3 could have fallen into the cistern at an earlier date and died there. "Sherds from the upper soil layers inside the cistern had been abandoned through the Early Mameluk period before it was sealed" (Blaine 1978: 183 and fig. 17).

Tortoises provide more than just a meal. Their shells are used as bowls, as well as resonating chambers for lutes and lyres (see Boessneck and Kokabi 1981: 150). The hypoplastron of a young turtle from the Iron Age (C.1:134, Stratum 18, 1150-900 B.C.) shows a hole with smooth edges next to the median suture, bored after the animal had died (pl. 8.10). The opening is more than 0.5 cm. It is certainly imaginable that a string drawn through this hole and a matching one on the other half of the hypoplastron gave the ventral shell plate some household function. Because the plates from younger animals fall apart easily, however, one would expect such holes only on the bony plates of adults. The three skeletons are not large as indicated in table 8.38.

Table 8.38 Measurements of tortoise, *Testudo graeca terrestris*, shells.

Locus	Measurement
B.2:135	GL ventral shell 13 cm.
G.4:11	GL ventral shell *ca.* 12.5 cm.
G.12:3	GL ventral shell less than 10 cm; young animal.

Among the other tortoise remains are some from larger specimens. Based on the first third of a ventral plate (F.37:1, Modern) one would estimate the GL of the ventral plate to be at least 15 cm. Perhaps there were even larger animals (table 8.39), but they came nowhere near reaching the extraordinary size of some *Testudo graeca ibera* specimens. *Testudo graeca terrestris*, the tortoise subspecies found in Palestine (Wermuth and Mertens 1961: 210), remained smaller. Its characteristic highly rounded dorsal shell can be readily seen in one case (H74E.4:7, pls. 8.11a, b). In larger specimens the craniolateral and caudolateral marginal plates extend farther out.

Hardoun, *Agama stellio*

The hardoun (see fig. 5.36 above), found throughout Palestine, lives in the walls and rocks

Table 8.39 Bone measurements of the tortoise, *Testudo graeca terrestris*.

a) Scapula

Loc	B.2:135	C.1:5	G.4:11	F.37:1
Strat	15	3	2	16
GL	48	49.5	(43.5)	48.2

b) Humerus

Loc	B.2:135	D.6:62	C.1:5	D.6:2	G.4:11	F.37:1
Strat	15	11	3	2/3	1	16
GL	34.5 34	33	39	(35)	32.3 32	36.3

c) Femur

Loc	B.2:135	C.1:5	G.4:11
Strat	15	3	2
GL	32	(36.5)	30.3 30.5

(Bones from the same locus belong to the same individual.)

on Tell Hesban, predominantly after the town fell to ruins. It was seen:

> almost everywhere, often by the dozen or in even greater numbers on stones, rocks, walls and houses, the walls of which he climbed as easily as the sloping stone surfaces.... The "slingtail" carries its head high and thus gave the impression of being a very industrious, bold, and brave creature. (Pechuel-Loesche 1893: 59)

This imposing *Agama* had no cultural significance; hence the dating of the following collected finds is superfluous, as shown by the example of the hardoun femora belonging together from H73G.10:3 and H73G.10:4 (table 8.40).

Table 8.40 Bones of the hardoun, *Agama stellio*.

Locus	Dates	Description
H71D.6:4	A.D. 1400-1456	Half of a lower jaw; GL 34.6 (pl. 8.16b).
H73D.4:12	A.D. 1260-1400	Femur, young animal; GL of diaphysis (24).
H73D.4:13	A.D. 1260-1400	Femur; GL of diaphysis 26.7.
H73D.4:21	A.D. 1260-1400	Tibia; GL of diaphysis 22.1.
H73F.16:6	A.D. 1870-1976	Maxilla (pl. 8.16a).
H73G.10:3	A.D. 1870-1976	Femur; GL of diaphysis 29.5; tibia, GL of diaphysis 22; possibly belonging together.
H73G.10:4	A.D. 1260-1400 but more probably belonging together with the find from G.10:3)	Femur, GL without distal epiphysis, from caput 29.7.
H74C.7:30	A.D. 1260-1400	Humerus from young animal; GL without distal epiphysis 19.1.
H76C.9:19	A.D. 1400-1456	Pelvis and sacrum belonging together.
H76F.30:3	A.D. 1260-1400	Dentale, femur; GL of diaphysis 27.5; MNI=1.

When any possible connection between bones found in places widely separated from one another is excluded, it is found that the 13 bones belong to at least 9 individuals.

Scheltopusik, *Ophisaurus apodus*

Unfortunately, the original location of the remains of a scheltopusik (see pl. 5.7 above) recovered in 1976, a relative of the well-known slow worm cannot be determined. From a very large specimen, nearly 1.5 m long, were found the upper cranium (pls. 8.19a, b), both halves of the mandible (pl. 8.19c), 5 vertebrae, and 24 ribs. See table 8.41.

Table 8.41 Bones of the sheltopusik, *Ophisaurus apodus*.

Bone	Measurement
Parietal	GL 32.8 (pl. 8.19a).
Maxilla	L row of teeth 23.5 (pl. 8.19b).
Dentale	L row of teeth; GL dentale 36.5 (pl. 8.19c).

Both Mertens and Wermuth (1960: 88) and Grzimek (1971: 314ff.) put Jordan and Palestine outside the area inhabited by the scheltopusik, although Tristram (1884: 151) mentions it under the name of *Pseudopus apoda* in connection with Mt. Hermon and refers to sightings "in other places as well." The species is also mentioned in the list of reptiles in Israel (Hoofien 1972).

Racer, *Coluber* Species

First of all, let us compile the finds together with the suggested dating (table 8.42). Before placing these finds in definite archaeological time periods, one must consider that racers lived on the hill, at least during the time in which it was not inhabited. In their search for food, they entered mole rat tunnels, which interlace the tell several meters deep. Thus, snakes and mole rats inserted themselves into the remains of cultural periods older than those during which they flourished. Such being the case, the cast-off snakeskin cannot be positively placed in the Umayyad period, nor the remains of the snake skeleton definitely dated

Table 8.42 Bones of the racer, *Coluber* species.

Locus	Dates	Description
H73D.4:1	A.D. 1400-1456	1 precaudal vertebrae.
H74A.7:102	A.D. 661-750?	Several shreds from a snakeskin.
H76C.5:161	A.D. 1260-1400	6 pieces from the cranium, both mandibles (dentale to jaw joint); 154 precaudal and caudal vertebrae; 138 ribs; GL of mandibles 35.7 (pl. 8.17).
H76C.5:167	A.D. 1260-1400	73 precaudal vertebrae; 140 ribs from the thickest section of the trunk.
H76C.8:22	A.D. 1260-1400	1 precaudal vertebra.
H76C.9:36	A.D. 1260-1400	19 precaudal vertebrae from 1 individual.
H76F.30:3	A.D. 1260-1400	2 precaudal vertebrae, probably from 1 individual.

to the Mamluk period. On the other hand, all don't necessarily have to be of recent date.

While assembling the remains of the skeletons, we noticed how the collected finds from H76C.5:161 and H76C.5:167 resembled each other, as if all these bones, found within the space of two days (July 13 to July 15) belonged to one single animal, a snake well over one meter in length. Due to careful collection, D. Robertson was able to assemble 227 vertebrae and 278 ribs from one single specimen. By comparison, on a single racer skeleton from our collection we counted 300 vertebrae, on a ring snake (*Natrix natrix*) 230. There are species of snakes, however, such as "slim racer and giant snakes," which "can have up to 435 vertebrae" (Grzimek 1971: 348). Mixed together with the bones of this racer were found, in H76C.5:161, numerous ones from two young mole rats (*Spalax leucodon ehrenbergi*) which in all probability were eaten by the snake shortly before its death.

In addition to the skeleton in relatively good condition just discussed, the remaining finds give an MNI of 4, when the different find locations are considered.

The species of snakes were not able to be determined, due to a lack of material for comparison. The vertebrae are similar and all four individuals appear to be of the same species. All these snakes were large, so smaller species are eliminated at once. We considered *Coluber jugularis*, but the skull bones were not identical. In contrast, *Coluber rhodorhachis* matches the shape, but is smaller. *Elaphe*, *malpolon*, and other genuses could be excluded based on morphology.

Variegated Toad, *Bufo viridis*

Well adapted to life in dry biotopes, the variegated toad (see fig. 5.37 above) has surely lived on Tell Hesban since antiquity. Nevertheless, most of the bone finds from this species came from the Modern period, even when they were rediscovered from sites of older cultural layers. This was taken into consideration in the definitive dating of the find sites. Even when some of the toad bones were clearly culturally connected, they still were not cultural products. However, we list the finds in detail, to show where disturbances are to be expected (table 8.43). When the remains of several individuals are found at a single location, one must realize that variegated toads live together in suitable hollows, and in case of misfortune die together.

A total of 71 variegated toad bones are present, belonging to at least 14 animals: 6 adult females, 2 females in second year, 1 adult male, 2 males in second year, and 3 of undetermined sex. Table 8.44 includes measurements taken from adult bones, which show that in the southern part of their

Table 8.43 Bones of the variegated toad, *Bufo viridis*.

Locus	Dates	Description
H73F.16:5	A.D. 1870-1976	48 bones from at least 4 females (3 adult, one in second year and 1 male in second year).
H74E.4:2	A.D. 1870-1976	Humerus, male, second year.
H76C.8:23	A.D. 1260-1400	Ilium.
H76F.30:3	A.D. 1870-1976	Humerus, right and left femora, tibiofibula, and tibiotarsus; one individual, male, large.
H76F.38:7	A.D. 1870-1976	Os cruris.
H76F.38:8	A.D. 1870-1976	Humerus, right and left, Femur: 1 individual, female.
H76F.31:14	A.D. 614-661?	Os antebrachii.
H76K.1:4	A.D. 1400-1456?	12 bones from at least 2 adults and 1 young female.

Table 8.44 Selected bone measurements of the variegated toad, *Bufo viridis*.

Bone	Measurements
Humerus	GL with epiphysis, female 23.5; GL without proximal epiphysis, male 26.5[1]; female 23.2[2], female 22.
Os antebrachii	GL with epiphysis 17; GL without distal epiphysis 18; 17; 15.7; 14.5.
Femur	GL without proximal epiphysis, male 29.5[1]; GL without ephiphysis male 28.1[1], female 26.1[2].
Os cruris	GL with epiphysis 25.7; GL without epiphysis 25.2, 23.3, 23.2; Talus/ Calcaneus: GL with epiphysis, male 17.5[1].

[1] Belong together (male). [2] Belong together (female).

range, the variegated toads are larger than in the northern part (see Boessneck and von den Driesch 1979a: 364ff.). This is to be expected, considering climatic conditions (see also Boessneck and von den Driesch 1975: 102; Krauss 1975: 185).

Conclusions

The majority of the avian bone remains are, without doubt, archaeological cultural products, namely kitchen waste; but this part of the finds comes from only about a dozen of the 45 established avian species (table 8.8). The domestic chicken alone accounts for over 81% of the bird bones. These, together with the partridge (7.5%), domestic pigeon and rock dove (4.5%), domestic goose, corncrake, great and Houbara bustard, coot, sandgrouse, and sand partridge (all of which certainly decked the table) already come to over 95%.

The carved bones from the crane and the griffon vulture, as well as the ostrich bones, are clearly also culturally related. On the other hand, most of the other finds are remains from birds which were killed by inhabitants of the city for no special purpose (in part without rhyme or reason) or died due to predators or accidents. Some species followed civilization to the Hesban area in search of food, for example: the Egyptian vulture, the kestrel, and the raven. Others, such as the barn owl, little owl, laughing dove, starling, larks, wheatear, and sparrow lived permanently in the town. Some bones also accumulated at Tell Hesban when the tell had no human inhabitants. At these times it was an "El Dorado" for owls, falcons, small birds, and reptiles, not to mention the numerous mammals. Only the tortoise, from among the collected reptile and toad remains, actually belongs to cultural material.

Avian bones account for less than 5% of the total bone find from Tell Hesban. Since the domestic chicken accounts for over 80% of all the bird bones, and chicken-dove-goose bones together make up over 86%, only a small part of the total bone corpus comes from wild bird species. The partridge was the only bird appreciably hunted. It accounted for 229 finds, compared to only 191 pieces from all the other species of wild birds (not counting the rock dove), by far not all of which were hunted.

In several places, remains of various species of small animals were found alongside the bones of domestic ones. They were not listed in the excavation reports because they couldn't be identified. The two most heterogeneous collections were subsequently compiled and are presented below. (The numbers in parentheses indicate the number of pieces found.)

Collection 1

F.30:3, ostensibly Early Mamluk period (A.D. 1260-1400); soil fill in tomb shaft and arcosalia: wheatear (2), blackbird (1), starling (1), hardoun (2), racer (two vertebrae), variegated toad (four pieces from one male individual). Davis mentioned: "There were non-human bones—17 sheep, 3 chickens, and 1 dog" (1978: 136).

Collection 2

F.38:2, Modern (A.D. 1879-1976); Soil layer in cave probe: little owl (2), corn bunting (1). F.38:8, Modern (A.D. 1879-1976); soil fill in loculus at south end of south probe: little owl (1), crested lark or skylark (2), wheatear (1), bunting (2), unidentified young songbird (2), variegated toad (three pieces from one female). F.38:9, common raven bones (3) are also listed here; no doubt an intrusion from more recent times. Davis reports of the rest: "the bones of common domestic animals (sheep, goats and donkeys) were very much in evidence" (1978: 144).

Based on the preserved condition of the bones, they cannot be interpreted simply as undigested remains of owl castings, although there may be some such among the finds.

There were no surprises among the species of birds identified from Tell Hesban. They were just what would be expected in this climate and geography. Although the list of 42-43 wild bird species is more extensive than had ever before been found in the Near East, one has the impression, especially by the small birds, that it was to a great extent chance. This would not change even if the list were doubled (see Boessneck and von den Driesch 1979a: 216).

As far as the remains from birds, reptiles, and toads are concerned (coming from natural deaths, which is the case as we have said for the great majority), in our opinion the archaeological effort spent on their careful recovery was not wasted. They present us with information for comparisons with respect to zoology. But even if the laborious work of identification was an end in itself, the effort was justified. The exactness of this method may pay for itself first when several single finds are compared together. Perhaps the findings presented here will contribute something toward putting together a complete picture of Tell Hesban.

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Chapter Nine

FISH REMAINS
FROM TELL HESBAN, JORDAN

Johannes Lepiksaar

Chapter Nine

Fish Remains from Tell Hesban, Jordan

Introduction

Of the fish remains from the archaeological excavation at Tell Hesban, approximately 94% (872 bone units) have been more closely identified anatomically and taxonomically (at least to the generic level). These finds represent 17 different species of fish, both of limnic and marine origin (table 9.1). Illustrations of many of the species described below will be found above in chapter 5.

The freshwater fish were apparently caught by local fishermen in the nearby waters of the Jordan system. Most of them belong to the catfish, *Clarias lazera* (about 48% of the finds of freshwater fish), and to 2 species of Cichlidae (45%). Less abundant (only 7%) are the remains of the Cyprinidae (a large species of *Barbus* and very likely the *Varicorhinus damascinus*, as well).

The remains of marine fish are much more abundant. They seem to have been primarily imported from the Red Sea, and to a lesser extent from the Mediterranean. Among the Mediterranean fish one must include the Serranidae (a big stone bass, *Polyprion americanus*, and a species of the genus *Epinephelus*), a big Sciaenid (apparently the meager, *Johnius hololepidotus*), and a sparid fish (the gilthead, *Sparus auratus*). Two species of grey mullet (Mugilidae) and the remains of the auxid (*Auxis thazard*) may also be of Mediterranean origin. The bulk of the fish remains consists of the Red Sea forms: 3 species of the parrot fish, Scaridae (*Scarus* sp., *cf. P. harid* and/or *Sparisoma* sp.), and 2 species of medium-sized tunny (the oceanic bonito, *Katsuwonus pelamis*, and an indopacific form, possibly *Euthynnus affinis*).

The anatomical analysis of the remains (including the relative frequency of different parts of the skeleton and the relation between the find numbers from left and right side in the pair of bones) indicates a heavy taphonomical loss.

Table 9.1 Fish from Tell Hesban, Jordan.

- Order CYPRINIFORMES, carp and catfish
  - Suborder CYPRINOIDEI, carplike fish
    - Family Cyprinidae, minnows
      - *Barbus* sp, probably *B. longiceps* and/or *B. canis*
      - *Gen.* sp., probably *Varicorhinus damascinus*
  - Suborder SILUROIDEI, catfish
    - Family Clariidae, eelshaped catfish
      - *Clarias lazera*
- Order PERCIFORMES, perches, bass and allies
  - Suborder PERCOIDEI, perch-like fish
    - Family Serranidae, bass
      - *Polyprion americanus*, wreckfish or stone bass
      - *Gen.* sp, probably *Epinephelus sp.*
    - Family Sciaenidae, drums and croakers
      - *Johnius hololepidotus*, meager
    - Family Sparidae, sea breams
      - *Sparus (Crysophrys)* sp., probably *S. (Chrysophrys) aurata*, gilthead
    - Family Cichlidae, combs
      - *Tilapia galilaea* and/or *Tilapia nilotica*
      - *Gen.* sp., probably *Tristramella sacra* or *T. simonis*
    - Family Scaridae, parrot fish
      - *Sparisoma* sp.
      - *Pseudoscarus sp. cf. P. harrid*
      - possible *Pseudoscarus* sp.
  - Suborder MUGILOIDEI, grey mullets and allies
    - Family Mugilidae, grey mullets
      - *Mugil* sp. *cf. M. (Crenimugil) labrosus*
      - *Mugil* sp. *cf. M. (Liza) ramada*
  - Suborder SCOMBROIDEI, mackerel-like fish
    - Family Scombridae, mackerels and tunnies
      - *Auxis thazard*, frigate mackerel or auxid
      - possible *Katsuwonus pelamis*, oceanic bonito
      - possible *Euthynnus affinis*

Methodical Remarks

Quantitative Analysis

For the anatomical and taxonomical identification, the osteological collections of the Natural History Museum at Gotenburg (GNM) have been used. For reconstruction of the role of different species in the fishmeat consumption of the place, the find numbers have at first been transferred to the number of bone units (sum of all fragments of 1 bone). The Minimum Number of Individuals (MNI) has been estimated on them. The MNI has a value for the above named reconstruction only if the degree of taphonomical loss is regarded. This varies greatly from one species to another and the species may be under- or over-represented in the find material in their relation to the primary account of remains, initially left over by the inhabitants and consumers of the fish.

Taphonomical loss is caused by a cooperation of different destructive processes of either chemical

Table 9.2 Stratigraphic survey of finds (bone units).

	Archaeological Areas							
Family	A	B	C	D	F	G	?	Sum
Cyprinidae	-	-	4	-	4	1-2	-	9-10
Clariidae	8	1	32	12-13	1	8	-	62-63
Mugilidae	1	-	15-16	1	-	-	1	18-19
Serranidae	-	1	1	1	-	1	-	4
Sciaenidae	-	1	3	63	-	-	-	67
Sparidae	-	1	9	1	-	-	-	11
Cichlidae	1	-	14	9	-	34	1	59
Scaridae	1	1	114	4	5	6	7	138
Scombridae	2	4	4	453-469	-	-	22	485-501+71 frags
Sum	13	9	196-197	544-561	10	50-51	31	853-872

(climatic-edaphical), mechanical, or biological characters. At Tell Hesban, the climatical and pedological conditions seem to have favored the preservation of the osseous substance of the fish remains. The mechanical destruction seems mainly have occurred by heavy trampling over the bones lying on or beneath the soil surface. The more or less restricted selection among the skeletal elements, their frequency, and even bitemarks on the preserved remains, indicate a very strong biological destruction of the fish remains by scavenging animals (especially canids, and perhaps even by rodents and birds). The varying degree of taphonomical loss is shown by the asymmetry of the find-numbers between the right and left side of the body. It also may be partly deduced from the difference between MNI and MNI[1], and even from the representative value and relative loss degree of different skeletal elements. The latter values can be estimated by reckoning the percent of real find numbers in relation to the number expected according to the MNI (Lepiksaar 1975: 1, 2; Lepiksaar and Heinrich 1977).

Among fish, the permanent growth resulting in a larger variety of sizes allows distinguishing the individuals better than in other vertebrates. However, in the different size/age classes, the frequency of skeletal elements may be altered and different elements may be more abundant on one body side. As a common exponent, the total length of the fish may be determined from the different bones of the skeleton. The methods of estimating the length of fish from skeletal parts are discussed by Casteel (1976). The estimation of the total length can scarcely be very exact, but in restricted marginals, it may be very useful.

If the taphonomical loss is heavy (as at Tell Hesban) and the dispersal of bones from an individual skeleton is restricted, the MNI estimated on morphological-osteometrical grounds only for the whole material can be unrealistically small. In that case, an estimation with regard to distribution of individuals in parts of the excavating area, separated enough from each other to avoid the dispersal from an individual skeleton, and summing up the results, often leaves a more realistic value of individuals, the above named MNI[1] (tables 9.2-9.5).

Table 9.3 Stratigraphic survey of individuals (after MNI[1]).

	Archaeological Areas						
Family	A	B	C	D	F	G	Sum
Cyprinidae	-	-	2	-	2	1-2	5-6
Clariidae	4	1	10	3	1	6	25
Mugilidae	1	-	5-6	1	-	-	7-8
Serranidae	-	1?	1	1	-	1?	2(-4)
Sciaenidae	-	1	2	1	-	-	4
Sparidae	-	1	3	1	-	-	5
Cichlidae	1	-	4	2	-	5	12
Scaridae	1	1	21	3	1	2	29
Scombridae	1	1	1	27	-	-	30
Sum	8	5-6	49-50	39	4	14-16	120-123

Table 9.4 Stratigraphic survey of unidentified finds.

Family	Archaeological Areas A	B	C	D	F	G	?	Sum
Finds	3	-	22	16	-	1	6	48
Identified Finds	13	9	197	561	10	51	31	872
Sum	16	9	219	577	10	52	37	920
Identification %	81.2	100	89.9	98	100	98	83.8	94.8

Table 9.5 The number of bone units and the number of individuals.

Fish family	Number of bones found	MNI	MNI[1]	Asymmetry of sides up to	Relation to the initial amount of the remains
Cyprinidae	9-10	4	4-6	-	under-represented
Clariidae	62-63	17	25	5:14	under-represented, but probably over-represented compared to the Cyprinids, Mugilids, and Sciaenids because of their very resistant pectoral spines
Mugilidae	18-19	6-7	7-8	0:5	under-represented
Serranidae	4	2	2-4	-	possibly under-represented
Sciaenidae	67	4	4	-	number of bones extremely over-represented due to the well-preserved find of one individual skeleton, MNI and MNI[1] under-represented
Sparidae	11	5	5	3:2	under-represented very little, if at all
Cichlidae	59	6-7	12	5:0	highly under-represented
Scaridae	138	28	29	15:23	under-represented very little; over-represented in relation to the Cyprinids, Mugilids, Sciaenids, and Cichlids due to the much resistant jawbones and pharangeals
Scombridae	485-501	27	30	13:23	under-represented very little if at all; probably highly over-represented in relation to other species and groups (possibly due to salting)

Family Cyprinidae, Minnows

This includes *Barbus* sp., probably *Barbus longiceps* or *Barbus canis*, as well as an unidentified Cyprinid, perhaps *Varicorhinus*.

Taxonomical Remarks

There are 10 finds, including 2 branchiostegals and 2 ribs typical for Cyprinids, the carp or minnow family, in the excavation material from Tell Hesban (tables 9.6 and 9.7). One opercular (C.8:72.28), one lower pharyngeal with a tooth *in situ* (C.6:102.60), and a cleithrum (C.9:87.18) are typical for the barb genus (pls. 9.1-9.3). They come from relatively big barbs whose total length may be estimated to *ca.* 45-60 cm. The species, *Barbus longiceps* and *Barbus canis*, are said to be the most common in Palestine (Bodheim 1935). Two other opercularia exhibit a form different

Table 9.6 Anatomical survey of the Cyprinidae finds.

SKELETAL REGION Locus Number	Anatomical Character	Maximum Diameter (mm)	Total Length (*ca.* cm)
CRANIUM			
C.8:72.28	Operculare dext. of *Barbus* sp.	37+	40-50
F.41:6.4	Operculare dext. of *Varicorhinus* ?	17.5+	30-35
G.4:79.41	Operculare dext. of *Varicorhinus* ?	29.8	30-35
F.41:6.4	Branchiostegale	42+	-
F.41:6.4	Branchiostegale	52	-
C.6:102.60	Os pharyngeum inf. sin. of *Barbus* sp.	35+	50-60
F.41:6.4	Tripus sin. ?, much damaged	34+	-
BODY REGION			
Ribs, costae			
C.7:38.2	Costa: dorsal part	32.5+	-
G.14:7 ?	Costa: dorsal part	37+	-
Zonoskeleton			
C.9:87.18	Cleithrum dext. of *Barbus* sp.	55+	50-60

Table 9.7 Stratigraphic survey of the Cyprinidae finds.

Square Number	Total Length (*ca.* cm)	Anatomical Character & Code	Number of: bones	individuals
C.6	50-60	1(0:1) os pharyng. inf. (102. 60) of *Barbus* sp.	1	1
C.7	?	1 costa (38.2)	1	1
C.8	40-50	1(1:0) operculare of *Barbus* sp. (72)	1	1
C.9	50-60	1(1:0) cleithrum of *Barbus* sp. (87.18)	1	1
F.41	30-35	1(1:0) operculare of *Varicorhinus* ? (6.4)	1	1
	?	1(0:1) tripus (6.4), 2 branchiostegals(do.)	3	-
G.4	30-35	1(1:0) operculare of *Varicorhinus* ? (34)	1	1
G.14	?	1 costa (7)	1 ?	1 ?
Sum			9-10	6-7

from the barbs. They are characterized by 2 deep depressions on the inner side of the bone above the articular cavity and on the basis of the supra-articular process. Both of these bones (F.41:6.4; especially G.4:79.41) come from smaller fish such as the barbs named above, the total length may be estimated to *ca.* 30 cm. The most common Cyprinid of this size class in Palestine is *Varicorhinus damascinus* (pl. 9.4; see fig. 5.40). Unfortunately, recent concrete material is lacking for a direct comparison. Measurements for the species considered here are given in table 9.8.

Dispersal of Finds

There is no evidence for a dispersal of an individual skeleton outside an archaeological area. The remains of the big barb in the Squares C.6, C.7, and C.9 may be of the same individual. The total of the finds (distributed according to area, number of bones, and number of individuals) is given in table 9.9. MNI for the (probable) *Varicorhinus* is two, and 2 for *Barbus* sp. The sum of MNI[1] in different areas equals 2 for the (probable) *Varicorhinus*, and 2-4 for *Barbus* sp. (because the size of the branchiostegals and costae are more likely derived from *Barbus* than from *Varicorhinus*). MNI's are given in table 9.10.

Preservation and Its Probable Causes

The osseous substance is quite firm, there is no evidence of eventual preservation of fish for long distance transport or for storage. Thinner parts of the branchiostegals, the ribs, and of the pharyngeal bone have been broken off mechanically (perhaps by trampling). On the contrary, 2 of the relatively thin opercularia are entirely preserved with little

Plates 9.1-9.4 Cyprinidae finds: **1)** C.8:72.28, *Barbus* sp., Operculare dext., n. medialis; **2)** C.6:102.60, *Barbus* sp., Os pharyngeum inferius, n. dorsalis; **3)** C.9:87.18, *Barbus* sp., Cleithrum dext., n. dorsalis; **4)** G.4:79.41, *Varicorhinus damascinus*, Operculare dext., n. medialis.

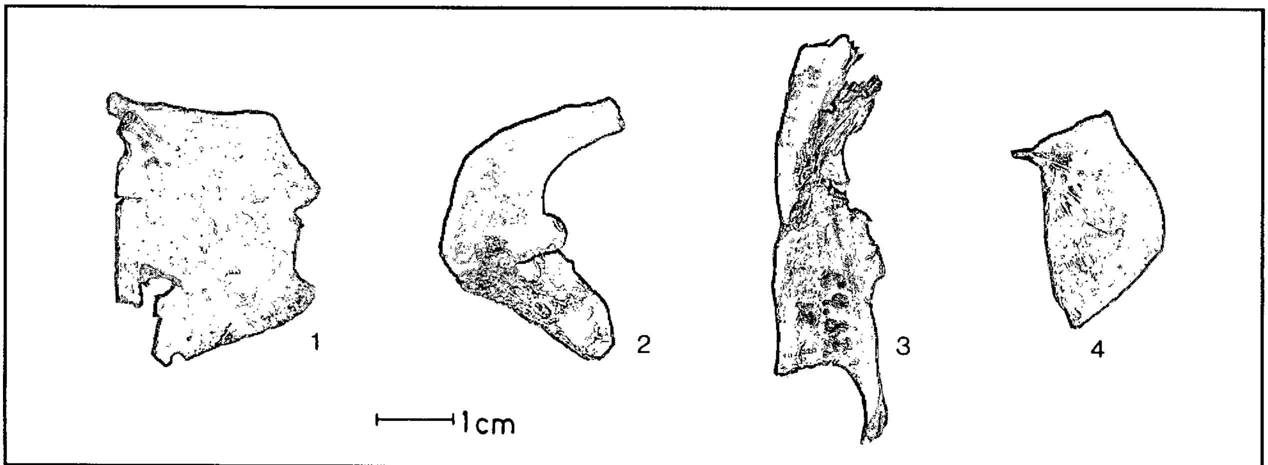


Table 9.8 Measurements of the Cyprinidae (in mm).

Operculare Species Locus Number	Side	Dorsal length	Ventral length	Oral height	Aboral height
Barbus sp. C.8:72.8	dext.	22.5	27+	37(+)	25(+)
Varicorhinus ?	dext.	14.3	16	26	19.8

damage. There are no finds from the fleshy main part of the body and none of the vertebrae. The fish may have been decapitated before preparing the food by the inhabitants and the heads cut off behind the cleithra been thrown in the refuse heap; however, even the elements of the crania are mostly lost. The preservation of such superficially and loosely placed bones as the operculars and the cleithrum, which very soon falls off from a cranium in decomposition and may be stored in the protective soil, may be indicative of the important role of scavenging animals for the destruction and loss of the inner part of a fish cranium. The scavengers especially preferred the fatty neurocrania with its brain content. As for that, the pharyngeal bone has also been left by the scavengers; this bone is very hard and fleshless.

Zoogeographical Remarks

Both *Barbus canis* and *Barbus longiceps* are endemic freshwater fish for Palestine. According to Bodenheimer (1935), the latter species is abundant in the waters of Lake Tiberias, and *Barbus canis* in the whole of Palestine (Lake Hula and Tiberias, the Jordan system). *Varicorhinus damascinus* is distributed from Asia Minor and southern Arabia to Syria and Israel, especially in the Jordan system (Sterba 1963). According to Bodenheimer (1935), it is the most abundant Cyprinid of Palestine.

Ecological Remarks

Like most of the Cyprinids, both the species of *Barbus* and *Varicorhinus* are freshwater fish. The

Table 9.9 Dispersal of the Cyprinidae finds.

Area	Number of Bones	Number of Individuals	Species
C	4	2	2 *Barbus* sp.
F	4	2	1 *Varicorhinus* ? 1 *Barbus* ?
G	1-2	1-2	1 *Varicorhinus* ? (1 *Barbus* ?)
Sum	9-10	5-6	2-4 *Barbus*, 2 *Varicorhinus*

Table 9.10 Minimum number of Cyprinidae individuals (MNI).

The most abundant skeletal element on the same side	Size classes in cm 30-35	40-50	50-60	Species
Operculare dext.	2	-	-	*Varicorhinus* ?
Operculare dext.	-	1	-	*Barbus* sp.
Os pharyng. inf. sin. & cleithrum dext.	-	-	1	*Barbus* sp.

MNI = 2 for *Varicorhinus* ?; 2 for *Barbus* sp.
MNI' (the sum of MNI in different areas) = 2 for *Varicorhinus* ?; 2-4 for *Barbus* sp. (based on their size, the remains of branchiostefals and costae are more likely derived from *Barbus* than from *Varicorhinus*).

Table 9.11 Anatomical survey of the Clariidae finds.

SKELETAL REGION Locus Number	Anatomical Character	Measures (in mm)	Total Length (*ca.* cm)
CRANIUM		Maximal Diameter	
C.8:31	Supraorbitale: fragment	40.5+	50
C.2:33	Supraoccipitale	30.2+	60
C.3:298.53	Supraoccipitale	32+	50
C.6:54	Supraoccipitale	34+	50
G.4:50.43	Hyomandibulare dext.	22+	55
G.4:26.49	Hyomandibulare sin.	30+	40
G.4:34	Quadratum dext.	25+	100
A.7:42	Quadratum sin.	30.2	60
C.6:91.57	Quadratum sin.	38.5+	60
D.2:121.30	Articulare dext.	33+	70
C.9:37	Articulare sin.	20.5+	50
D.2:121.30	Dentale dext.; 4 frags	-	70
D.5:8	Dentale dext.	30+	60
C.8:96	Dentale sin.	45.5+	50
G.11:24.20	Dentale sin.	52.8+	45
C.3:269.44	Keratohyale dext.	33.2+	50
C.7:97.48	Keratohyale sin.	30.4+	50
C.7:49	Keratobranchiale	34+	(50)
C.8:103.9	Keratobranchiale	50+	80
POSTCRANIAL *Columna vertebralis*		Medioventral length of corpus	
A.8:14	Vertebra praecaudalis	2.6	50
C.3:278.53	Vertabra praecaudalis	4.6	50
B.7:80.21	Vertabra praecaudalis	5.9	80
C.6:73	Vertabra praecaudalis	5.9	50
D.1:420	Vertabra praecaudalis	4	50
A.5:91.78.719/74	Vertabra praecaudalis	5	40
		Lateral length of corpus	
A.5:102.82	Vertebra caudalis	7	50
C.7:49	Vertebra caudalis	6.3	50
C.8:25	Vertebra caudalis	5.4	40
D.2:15	Vertebra caudalis	4.9	40
D.3:21	Vertebra caudalis	8.3	60
D.4:4	Vertebra caudalis	5.5	50
C.7:46	Vertebra caudalis: neurarcus-frag.	-	?
Unpaired fins		Maximal Diameter	
C.6:54	Pterygiophorus	27+	50
F.41:6.4	Pterygiophorus	42	70
Zonoskeleton & paired fins			
A.7:91.40	Cleithrum dext.: ventral part	59+	60
G.4:50.43	Cleithrum dext.: dorsal part	39.5+	50
G.4:59.42	Cleithrum dext.: ventral part	61+	55
C.3:269.44	Cleithrum sin.: dorsal part	44.3+	50
C.8:93.43	Cleithrum sin.	74.8	50
D.2:140.30a	Cleithrum sin.: ventral part	60.5+	50
D.6:63a	Cleithrum sin.: dorsal part	48+	60
D.6:63a	Cleithrum sin.: ventral part	48+	60
D.6:36	Cleithrum sin.: dorsal part	43.3	50
C.4:37.27	Spina p. pectoralis dext.	44.7	40
C.4:151.17	Spina p. pectoralis dext.	51.2	45
C.4:195.39.30	Spina p. pectoralis dext.	42.7	40
C.4:313.63	Spina p. pectoralis dext.	35+	50
D.6:8.5	Spina p. pectoralis dext.	53.5	50
A.7:11	Spina p. pectoralis sin.	35+	60
A.8:41.14	Spina p. pectoralis sin.	55.5	50
A.9:14.15	Spina p. pectoralis sin.	42+	50
C.2:303.9	Spina p. pectoralis sin.: pathologic	36.5+	50
C.3:123.14	Spina p. pectoralis sin.	43+	50
C.3:278.53	Spina p. pectoralis sin.	38.5+	50
C.4:28.18.5	Spina p. pectoralis sin.	59	60
C.4:35	Spina p. pectoralis sin.: apical part	37+	(50)
C.4:175.39	Spina p. pectoralis sin.	52.2	50
C.6:138.73	Spina p. pectoralis sin.	52.5	50
C.7:37.1	Spina p. pectoralis sin.	34.5+	50
D.2:121.30	Spina p. pectoralis sin.	47.8	50
G.3:132.17	Spina p. pectoralis sin.	29.5+	60
G.12:32.9	Spina p. pectoralis sin.	56	60
C.2:405.34	Lepidotrich	58+	-
	including:	63 2 keratobranchialia 2 pterygiophores 1 lepidotrich 19 (5:14) actinotrichs	

barbels prefer current waters. As young, they feed mainly on the invertebrates, bottom fauna, and even vegetable matter, the big ones preying even on small fish.

Economical Remarks

The flesh of the barbels is tasty, and rich on the intermuscular bones. The roe may occasionally cause poisoning. The barbs may be angled with a baited hook, but easily are taken by nets or purse-nets.

Occurrence at Tell Hesban

As has already been mentioned (see preservation), the finds of cyprinids must be highly under-represented due to the scavengers when compared with the initial amount of remains left by the inhabitants of Tell Hesban on this place. We can suppose that fresh fish has been taken from the freshwater in the vicinity of Tell Hesban, especially from Jordan and its tributaries, at all times in the occupation of this place.

Compared with the finds of other freshwater species, the catfish *Clarias* and the combs (family Cichlidae), the number of the Cyprinids is few. In all probability they were less consumed than those of other species. However, we also must reckon with the greater resistancy of some bones, especially the strong finspines (acanthotrichs) of *Clarias* and the Cichlidae.

Family Clariidae, Catfish

These include *Clarias lazera* Cuvier and Valencienne.

Taxonomical Remarks

There are 63 finds for this family of catfish (table 9.11), including also 2 pterygiophori, 1 lepidotrich, and 19 spines of the pectoral fin. There is no other species of this family in the area than the above named *Clarias lazera* (table 9.12; see pls. 9.5-9.13; also fig. 5.38).

Table 9.12 Stratigraphic survey of the Clariidae finds.

Square Number	Length (*ca.* cm)	Anatomical Character & Code	Number of bones	Number of individuals
A.5	40-45	Vertabra praecaudalis (91.78.719/74)	1	1
	50-55	Vertebra caudalis (102.82)	1	1
A.7	60-65	1(1:0) quadratum (42), 1(1:0) cleithrum (91.40), 1(0:1) spina p. pectoralis	3	1
A.8	50-55	Vertabra praecaudalis (14), 1(0:1) spina p. pectoralis (41.14)	2	1
A.9	50-55	1(0:1) spina p. pectoralis (14.15)	1	1
B.7	70-80	Vertebra praecaudalis (21)	1	1
C.2	50-55	1(0:1) spina p. pectoralis (303.9)	1	1
	60-65	Supraoccipitale (33)	1	1
C.3	50-55	Supraoccipitale (298.53), 1(1:0) keratohyale (269.44), Vert. praecaudalis (269.44) 1(0:1) cleithrum (269.44), 1(0:1) spina p. pect. (123.14), 1(0:1) do. (278.53)	6	2
C.4	40-45	1(1:0) spina p. pectoralis (195.39), 1(1:0) 1(1:0) spina p. pectoralis (37.27)	2	2
	50-55	1(1:0) spina p. pectoralis (151.17), 1(1:0) do. (175.29.5), 1(1:0) do. (313.63), 1(0:1) do. (35)	4	3
	60-65	1(0:1) spina p. pectoralis (28.18)	1	1
C.6	40-45	Vertebra praecaudalis (73)	1	1
	50-55	Supraoccipitale (E.54), pterygiophorus (E.54), 1(0:1) spina p. pect. (138.73)	3	1
	60-65	1(0:1) quadratum (E.98.51)	1	1
C.7	50-55	1(0:1) keratohyale (W.97.48), kerato-branchiale (49), Vert. caudalis (46), do. (49), 1(0:1) spina p. pect. (37)	5	1
	?	Vertebra caudalis: neurarcus (W.46)	1	-
C.8	40-45	Vertebra caudalis (25)	1	1
	50-55	Supraorbitale (31), 1(0:1) dentale (96), 1(1:0) cleithrum (93.43)	3	1
	70-80	Keratobranchiale (103.9)	1	1
C.9	50-55	1(0:1) articulare (37)	1	1
D.1	50-55	Vertebra praecaudalis (N.420.70)	1	1
D.2	50-55	Vertebra caudalis (15), 1(0:1) cleithrum (140.30 a), 1(0:1) spina p. pectoralis (121.30)	3	1
	70-80	1(1:0) articulare (121.30), 1(1:0) dentale (do.)	2	1
D.3	60-65	Vertebra caudalis (21)	1	1
D.4	50-55	Vertebra caudalis (4)	1	1
D.5	60-65	1(1:0) dentale (8)	1	1
D.6	50-55	1(0:1) cleithrum (W.63), 1(1:0) spina p. pectoralis (8.5)	2	1
	60-65	1(0:1) cleithrum (a.63a): two parts	1-2	1
F.41	70-80	Pterygiophorus (6.4)	1	1
G.3	60-65	1(0:1) spina p. pectoralis (132.17)	1	1
G.4	40-45	1(0:1) hyomandibulare (26)	1	1
	50-55	1(1:0) hyomandibulare (50.43), 1(1:0) cleith. (150.36), 1(1:0) do. (150.42)	3	2
	100	1(1:0) quadratum (34)	1	1
G.11	40-45	1(0:1) dentale (24.20)	1	1
G.12	60-65	1(0:1) spina p. pectoralis (32.9)	1	1
			62-63	40

Dispersal of the Finds

There is no evidence for dispersal of remains from an individual skeleton outside one area, but some of the fin spines may be displaced from one square to another. Remains of this catfish have been found from most of the areas and squares. They are lacking from Squares A.10, B.1, B.2, B.4, C.1, C.10, and G.14. For the excavation areas, the distribution of finds and individuals is given in table 9.13. MNI statistics are given in table 9.14.

Only very few skeletal elements are represented at all, and the number of vertebral finds is very small. Beside the skeletal elements named in table 9.15, the following are also represented in the find material: 1 supraorbitale, 2 keratobranchialia, 2 pterygiophori, and 1 lepidotrich.

It is very remarkable that of the armored neurocrania, only small pieces of supraoccipitalia and a fragment of the supraorbital plate are represented. The most frequent part of the catfish skeleton is the cleithrum and the very strong spines of the pectoral fin is articulated. Most of the cleithra are broken in a dorsal and a ventral part.

Preservation

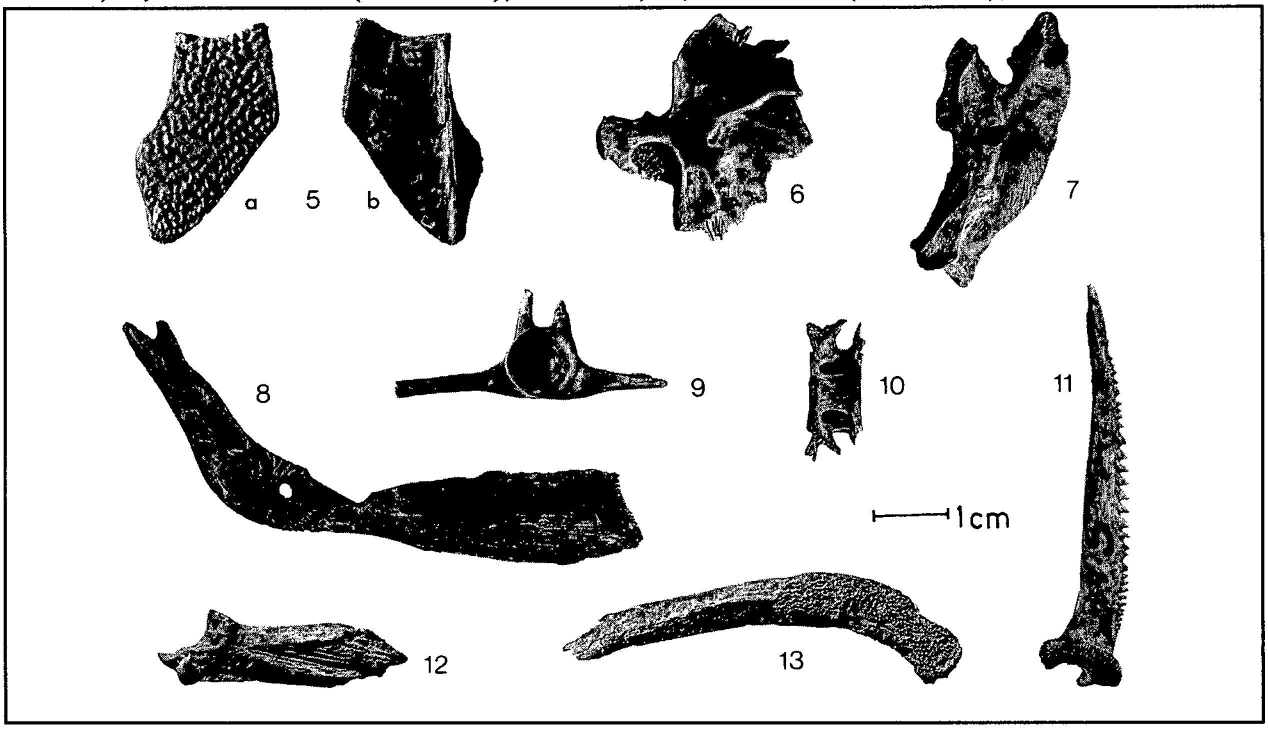
The osseous substance is well preserved. That of the fin spines, cleithra and cranial roof is very hard. The breaking off of the two last-named elements indicates a heavy mechanical destruction, probably by trampling. Possibly the fleshy hindparts, behind the armored head and the shoulder girdle, have been cut off by the inhabitants before preparing the food. The heads left in the refuse can be partly devoured by dogs, so only the hindmost parts attached to the very hardy shoulder girdle and the stinging fin spines remained.

Zoogeographical and Ecological Remarks

Clarias lazera inhabits the lakes and rivers from Syria, Palestine, and Egypt to Senegal and Niger.

These large catfish (up to 1.2 m) are especially adapted for a life in temporary freshwaters. Due to their accessory breathing apparatus, they may endure periods of drought in burrows of the dried out bottom mud or in the caverns of the riverbanks. They prey on fish and other small vertebrates.

Plates 9.5-9.13 All Clariidae finds are *Clarias lazera*: **5)** Supraoccipatale (C.3:298.53), 5a) n. dorsalis, 5b) n. ventralis; **6)** Hyomandibulare sin. (G.4:26.49), n. medialis; **7)** Hyomandibulare+Quadratum+Praeoperculare dext. (C.6:91.57), n. medialis; **8)** Cleithrum sin. (C.8:93.43), n. medioventralis; **9)** Vertebra praecaudalis (D.1:420); **10)** Vertebra caudalis (C.7:49), n. lateralis; **11)** Spina p. pectoralis (C.4:175.39), n. medialis; **12)** Articulare dext. (D.2:121.30), n. lateralis; **13)** Dentale sin. (G.11:24.20), n. dorsalis.



Economical Remarks

According to Bodenheimer (1935), the meat of this catfish "tastes insipid." Because of the "scaleless" body they were prohibited from consumption by the Mosaic law. Their large size, however, makes them a rich source of protein food.

Occurrence at Tell Hesban

From the number of catfish finds and their stratigraphic distribution, the meat of this species seems to be consumed in quite a large amount at all times. If one reckons with the very limited selection of this catfish skeletal parts among the finds, the strong asymmetry of the find number on each side, the heavy relative loss even in the most frequent parts, and the difference between morphologically estimated MNI and the sum of MNI in separate areas (MNI[1]), one must admit a strong under-representation of the MNI compared with the initial number of remains left by the 216

Table 9.13 Dispersal of the Clariidae finds.

Length	Bones							Individuals						
(*ca.* cm)	A	B	C	D	F	G	Sum	A	B	C	D	F	G	Sum
40-45	1	-	4	-	-	2	7	1	-	2	-	-	1	4
50-55	4	-	23	7	-	3	37	2	-	6	1	-	2	11
60-65	3	-	3	3-4	-	2	11-12	1	-	1	1	-	2	5
70-80	-	1	1	2	1	-	5	-	1	1	1	1	-	4
100	-	-	-	-	-	1	1	-	-	-	-	-	1	1
Unknown	-	-	1	-	-	-	1	-	-	-	-	-	-	-
Sum	8	1	32	12-13	1	8	62-63	4	1	10	3	1	6	25

Table 9.14 Minimum number of Clariidae individuals (MNI).

The most abundant skeletal element on the same side	Size classes in cm 40-45	50-55	60-65	70-80	100	
Spina p. pectoralis dext.	2	-	-	-	-	
Spina p. pectoralis sin.	-	9	-	-	-	
Spina p. pectoralis sin.	-	-	4	-	-	
Articulare, dentale	-	-	-	-	-	
Keratobranchiale, vert	-	-	-	-	-	
praecaudalis, pterygiophorus	-	-	-	-	-	
a 1	-	-	-	1	-	
Quadratum dext.	-	-	-	-	1	
MNI	2	9	4	1	1	Sum = 17

MNI[1] (the sum of MNI in different areas) = 25
MNI[1]:MNI 1.47

consumers. Maybe the MNI[1] number of 25 individuals is more realistic than the MNI of only 17. Measurements for the species considered here are given in table 9.16.

Family Mugilidae, Grey Mullets

This includes *Mugil* sp.: *Mugil (Crenimugil) labrosus* Risso (also known as *Mugil chelo* Cuvier) and *Mugil (Liza) ramada* (also known as *Mugil capito* Cuvier; see fig. 5.41).

Taxonomical Remarks

According to the form of opercularia and caudal vertebrae, there are at least two different species represented in the material from Tell Hesban. The opercularia from C.5:10, C.5:84, and C.6:21 (pl. 9.14)—mainly articular parts only preserved—are quite similar to those from recent thick-lipped mullet, *Mugil (Crenimugil) labrosus* (table 9.17). So also are the vertebral finds from C.9:37 (pls. 9.15 and 9.18) with their more strangular, rather than poric, structure of the vertebral sides (table 9.18). A praeoperculare from C.6:73 is shown in

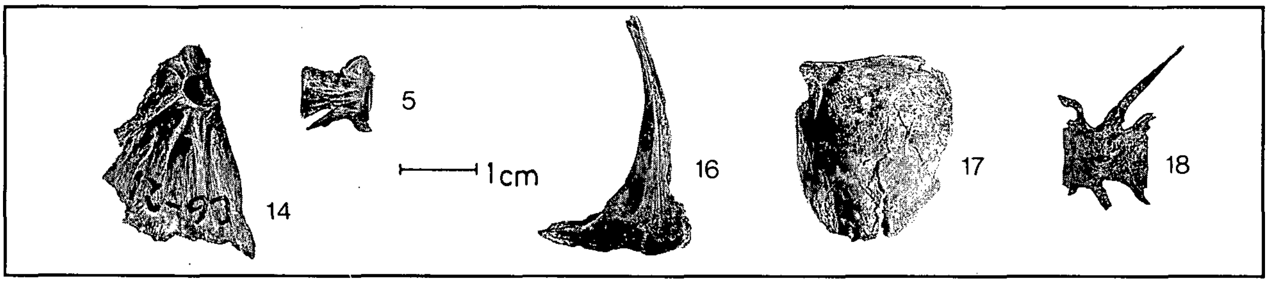
Table 9.15 Clariidae: 1) Frequency, 2) Symmetry of the Sides, 3) Relative Representation, 4) Relative Loss.

Skeletal Elements	1	2	3	4
Unpaired				
(expected 17)				
Supraoccipitale	3	-	17.6%	82.4%
Paired				
(expected 34)				
Spina p. pectorales	19	5:14	55.9%	44.1%
Cleithrum	9	3:6	26.5%	73.5%
Dentale	4	2:2	11.8%	88.2%
Quadratum	3	1:2	8.8%	91.2%
Hyomandibulare	2	1:1	5.9%	94.1%
Articulare	2	1:1	5.9%	94.1%
Keratohyale	2	1:1	5.9%	94.1%
Serial				
(expected 11 x 17 = 187)				
Vertebrae precaudales lib.	6	-	3.2%	96.8%
(expected 47 x 17 = 799)				
Vertebrae caudales	6	-	0.7%	99.3%

Table 9.16 Clariidae measurements.

Locus Number	Measures (in mm)			
Quadratum	Side		Articular width	
C.6:91.57	sin.		7.8	
A.7:42	sin.		8	
G.4:34	dext.		12.1	
Vertebrae	Medioventral length of corpus v.		Horiz. and vert. diam. of the contact surface of corp. vertebrae cranial	caudal
A.8:14	2.6		10 × 9.1	10 × 8.5
D.1:420	4		9 × 9.2	8.5 × 9
C.3:278.53	4.6		10 × 9.8	10 × 9.8
B.7:80.21	5.9		20.4 × 16	
V. praecaudales post.				
A.5:91.78.619/74	5		7.3 × 7.2	7.1 × 7.1
C.6:73	5.9		8.4 × 8	8.4 × 8
V. caudales	Lateral length of corpus			
D.2:15	4.9			
D.4:4	5.5		8.5 × 8.1	8.5 × 8.2
C.8:25	5.4		8 × 7.7	(7.5 × 7.1)
C.7:49	6.3		10.5 × 10.3	11 × 10
A.5:102.82	7		-	12 × 11.6
D.3:21	8.3		16.5 × 16	17 × 16
Cleithrum	Side		Chordal height	
C.8:93.43	sin.		74.8	
Spina p. pect.	Side	Length	Diam. of the basal articulation	
C.4:195.39	dext.	42.7	10.3	
C.4:37.27	dext.	44.7	9.9	
D.2:121.30	sin.	47.8	12	
C.4:151.17	dext.	51.2	11.4	
C.4:175.39	sin.	52.2	11.2	
C.5:138.73	sin.	52.5	11.2	
D.6:8.5	dext.	53.5	(12)	
A.8:41.14	sin.	55.5	14.6	
G.4:34/G.12:32	sin.	56	15	
C.4:28.18	sin.	59	13	

Plates 9.14-9.18 Mugilidae finds: **14)** *Mugil (Crenimugil) labrosus*, Operculare sin. (C.6:21), n. medialis; **15)** *Mugil (Crenimugil) labrosus*, Vertebra caudalis (C.9:37), n. lateralis dext.; **16)** *Mugil* sp., Praeoperculare sin. (C.6:73), n. lateralis; **17)** *Mugil (Liza) ramada*, Operculare sin. (C.8:106.46), n. medialis; **18)** *Mugil (Liza) ramada*, Vertebra caudalis (D.3:248.52d), n. lateralis sin.



pl. 9.16. Finds are not known from Areas B, F, or G.

The opercularia from A.7:174.64 and C.8:106.46 (pl. 9.17) have their upper border behind the supra-articularis deeply insinuated. The side structure of corpus vertebrae from C.9:37 is characterized by fine pores similar to the same structure on caudal vertebrae of *Mugil (Liza) ramada*.

There are several species of mugilids both in the Mediterranean and in the Red Sea. Unfortunately, a comparative material of recent species besides the above named was not available. From the Mediterranean forms, the *Mugil cephalus* and *Mugil (Liza) aurata* are of the same size class as the finds, the latter usually somewhat smaller.

Regarding the great value of these fish for the Mediterranean fishery since the classic times, it seems to be most likely that the grey mullets have been taken to Tell Hesban from the western sea coast.

Table 9.17 Anatomical survey of the Mugilidae finds.

SKELETAL REGION Locus Number	Anatomical Character	Measures (in mm)	Total Length (*ca.* cm)
CRANIUM		Maximal Diameter	
C.6:73	Praeoperculare sin.	32	40
C.5:84	Operculare sin.	22+	40
A.7:174.64	Operculare sin.	38+	35
C.5:10	Operculare sin.	22.5+ & 29.5+	40
C.6:21	Operculare sin.	29.5+	40
C.8:106.46	Operculare sin.	24	30
C.5:91	Interoperculare sin.	18.5+	40 ?
BODY REGION			
Culumna vertebralis		Medioventral length of corpus vert.	
C.9:14	Vertebra praecaudalis (*ca.* VII)	8.9	40
		Lateral length of corpus vert.	
C.9:37	Vertebra caudalis	8.5+	40
C.9:37	Vertebra caudalis	8.9	40
C.6:35	Vertebra caudalis	12.3	50
D.3:248.52d	Vertebra caudalis	10.8	45
C.7:38.2 ?	Urostyl	30.2	60
C.8:18	Urostyl	22	40
Unpaired fins			
C.?:26 ?	Spina p. dorsalis	44	-
C.6:54 ?	Spina p. dorsalis	41.5	-
Undated	Spina p. dorsalis	45	-
C.8:23 ?	Lepidotrich	38.7	-
Zonoskeleton			
C.6:73	Cleithrum dext.	28.6+ & 36.2+	40
		18-19 (including: 3 acanthotrichs 1 lepidotrich)	

Dispersal of Finds

No evidence of dispersal of an individual skeleton exists outside an area. Some of the operculars from Area C (*e.g.*, the praeopercular from Square C.6 and the interoperculare from Square C.5) may be from the same individual. Summing up the finds and MNI from different squares of the same area, the distribution is as presented in tables 9.19-9.21.

Preservation

The osseous substance is fairly well preserved. The fish have probably not been salted. Mechanical destruction (possibly trampling) seems to have been quite heavy. Most of the skeletal parts are lacking and the vertebral finds are very few. The absence of neurocranial parts may indicate the great role of scavenging animals in the destruction process. Indirectly, the same conclusion may be drawn from the remarkable frequency of the thin opercularia. They are easily lost from the heads and can be protected by the soil.

Table 9.18 Stratigraphic survey of the Mugilidae finds.

Square Number	Length (*ca.* cm)	Anatomical Character & Code	Number of bones	Number of individuals
A.7	30-40	1(0:1) operculare (174.64)	1	1
C.5	30-40	1(0:1) operculare (10), 1(0:1) do. (84), 1(0:1) interoperculare (91)	3	2
C.6	30-40	1(0:1) praeoperculare (73), 1(0:1) operculare (21), 1(1:0) cleithrum (73)	3	1
	45-55	Vertebra caudalis (35)	1	1
	?	Spina p. pectoralis (E 26), do.(E 54)	2	-
C.7	60	possible urostyle (38.2)	1?	1?
C.8	30-40	1(0:1) operculare (106.46),urostyle (18)	2	1
	?	Lepidotrich (23)	1	-
C.9	30-40	Vertebra praecaudalis (14), 2 do. caudales (37)	3	1
D.3	45	Vertebra caudalis (248.52d)	1	1
undated	?	Spina p. dorsalis	1	-
			18-19	8-9

Zoogeographical Remarks

Mugil (Crenimugil) labrosus and *Mugil (Liza) ramada* are the Mediterranean species of the family occurring also in Eastern Atlantic northward to SW Norway. So is also *Mugil (Liza) aurata* (northwards to the Northern Sea). *Mugil cephalus* is more southern and beside the Mediterranean, occurs on both sides of the Atlantic.

Ecological Remarks

The grey mullets are specialized for feeding on minute plants (especially algae) and animals sucking and filtrating them from the bottom bud or scraping them from the surface of rocks and seaweeds. They inhabit mainly the seashore, but often enter even the estuaries and lower parts of the rivers.

Table 9.19 Dispersal of Mugilidae finds.

Total Length (*ca.* cm)	Bones A	Bones C	Bones D	Bones ?	Bones Sum	Individuals A	Individuals C	Individuals D	Individuals Sum
30-40	1	11	-	-	12	1	4	-	5
45-55	-	1	1	-	2	-	1	1	2
60	-	1?	-	-	1?	-	1?	-	1?
Unknown	-	3	-	1	4	-	-	-	-
Sum	1	15-16	1	1	18-19	1	5-6	1	7-8

Economical Remarks

The grey mullets are schoal fish which may be caught by active netting in the shorewaters. The Mullets may try to escape out of the nets by looping. The meat of grey mullets is much valued, and catches have even been held alive locally in enclosed lagoons.

Table 9.20 Minimum number of Mugilidae individuals (MNI).

The most abundant skeletal element on the same side	Size classes in cm 30-40	45-55	60	
Operculare sin.	5	-	-	
Vertebra caudalis (indiv only)	-	1	-	
? urostyle	-	-	1 ?	
MNI	5	1	1 ?	Sum 6-7
MNI' the sum of MNI in different areas				Sum 7-8
MNI':MNI 1.2-1.1				

Occurrence at Tell Hesban

The very narrow selection of the skeletal parts and the strong asymmetry of the find numbers on both sides of the body indicates a heavy loss of the remains initially left by the consumers. Probably this loss is mainly due to the scavenging animals. After the asymmetry of the most frequent finds (opercularia, 0:5) it may be quite realistic to reckon with at least 30-35 fish represented by the finds. The grey mullets were obviously imported to Tell Hesban from the Mediterranean. This relatively short transport way allowed them to be brought fresh to the consumers. Measurements for the species considered here are given in table 9.22.

Table 9.21 Mugilidae: 1) Frequency, 2) Symmetry of the Sides, 3) Relative Representation, 4) Relative Loss.

Skeletal Elements	1	2	3	4
Unpaired				
(expected 6-7)				
Urostyale	1-2	-	-	-
Paired				
(expected 12-14)				
Operculare	5	0:5	41.7%	58.3%
			35.7%	64.3%
With 1 find only: praeoperculare, interoperculare, cleithrum				
Serial				
(expected 11 × 6-7 = 66-77)				
Vertebrae praecaudales	1	-	1.5%	98.5%
			1.3%	98.7%
(expected 12 × 6-7 = 72-84)				
Vertebrae caudales	4	-	-	-
			5.5%	94.5%
			4.8%	95.2%

Represented are also: 3 spinae p. dorsalis, 1 lepidotrich (the ribs and pterygiophori perhaps are not recognized)

Table 9.22 Mugilidae measurements.

Bone Locus Number		Measures (in mm)		
Praeoperculare				
	Side	Chordal ht.	Ventral lgth	Dorsal lgth
C.6:73	sin.	31.8	20.1	32
Operculare		Diameter: cavitas artic. + processus supraartic.		
C.8:106.46	sin.	5.4		*cf. ramada?*
A.7:174.64	sin.	7		*cf. ramada?*
C.5:(10)	sin.	7.9		*cf. labrosus*
C.6:21	sin.	10		*cf. labrosus*
C.5:84	sin.	11.4		*cf. labrosus*
Vertebra praecaudalis				
	Medioventral length of corpus	Diam. of contact surface of corpus vert.; horiz × vert		
		cranial	caudal	
C.9:14	8.9	-	6.8 × 6	*cf. labrosus*
Vertebra caudalis				
	Lateral length of corpus			
C.9:37	8.9	7 × 6.2	6.4 × 6	*cf. labrosus*
D.3:248.52d	10.8	8 × 7.7	-	*cf. ramada*
C.6:35	12.3	9.4 × (9.3)	10 × 9.3	*cf. ramada*

Family Serranidae, Sea Perches or Basses

This includes *Polyprion americanus* Block and Schnieder, the wreck fish or stone bass and also an unidentified serranid, perhaps an *Epinephelus* sp., the grouper.

Taxonomical Remarks

The large dental from D.4:286.135 (pl. 9.19) shows a great similarity with the corresponding part of recent stone bass (see fig. 5.42). Its large size and uniformly cardlike teeth eliminate a confusion with other forms of the family (table 9.23). The basioccipital from B.1:364.147 and 2 praecaudal vertebrae (I and III) from G.12:47.13 (pl. 9.20) and C.5:310 (pl. 9.21) exhibit many common characteristics in their form and preservation. They seem to come from the same species of serranid. The basioccipital comes from a fish of *ca.* 60-70 cm, and the vertebrae from a somewhat smaller individual of *ca.* 50 cm (table 9.24). In all likelihood, they derive from a species of the genus *Epinephelus*.

Preservation

The osseous substance of this single stone bass find is quite hard, yet both rami of the hinder part have been broken off (possibly by trampling) and only the anterior portion of the bone with the symphysis is left. The fish seems not to be salted.

Zoogeographical and Ecological Remarks

The stone bass is atlanto-mediterranean

Plates 9.19-9.21 Serranidae finds: **19)** *Polyprion americanus*, Dentale sin. (D.4:286.135), n. lateralis; **20)** *Epinephelus* sp., Vertebra I (G.12:47.13), n. cranialis; **21)** *Epinephelus* sp., Vertebra praecaudalis (C.5:310), n. lateralis.

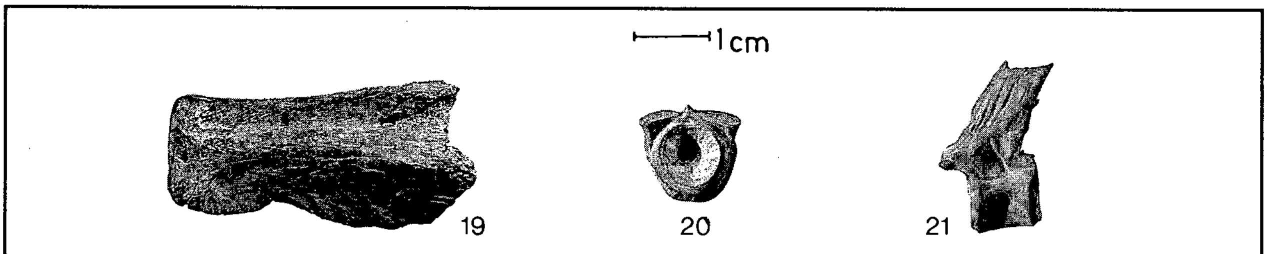


Table 9.23 Serranidae measurements (an unidentified serranid, perhaps *Epinephelus* sp.).

Element	Measures (mm)
Symphyseal height	16
Height in the postsymphyseal constriction	13.2
Maximal width of the toothfield	9.8

species, preferring warmer waters. It preys mainly on other fish, inhabiting rocky ground where it holds itself near a crevice or cave. Elder individuals are solitary and prefer water up to 500-750 m.

Economical Remarks

Its tasty meat and large size make the stone bass a coveted foodfish. Because of its solitary habits,

Table 9.24 Anatomical survey of the Serranidae finds.

Locus Number	Anatomical Character	Measures (in mm)	Total Length (*ca.* cm)
		Maximal Diameter	
B.1:364.147	Basioccipitale	27+	60-70
		Medioventral length of corpus vert.	
G.12:47.13	Vertebra praecaudalis I	7.1	50
C.5:310	Vertebra praecaudalis (III)	9.3	50

Plates 9.22-9.36 All finds are Sciaenidae (cf. *Johnius hololepidotus)*; from Locus D.3:226.57c (except as noted): **22)** Statolith, 22a) n. interna, 22b) n. externa; **23)** Hyomandiublare dext., n. lateralis; **24)** Keratohyale sin., n. lateralis; **25)** Praeoperculare sin., n. lateralis; **26)** Operculare dext., n. medialis; **27)** Quadratum dext., n. medialis; **28)** Posttemporale dext., n. lateralis; **29)** Suboperculare dext., n. lateralis; **30a,b)** Vertebrae caudales, n. lateralis sin.; **31)** Urohyale, n. lateralis sin.; **32)** Cleithrum sin., n. lateralis; **33)** Interoperculare dext., n. medialis; **34a,b,c,d)** Vertebrae praecaudales, n. lateralis sin.; **35)** Supracleithrale sin. (B.4:511.283a), n. lateralis; **36)** Vertebra caudalis (C.2:427), n. lateralis sin.

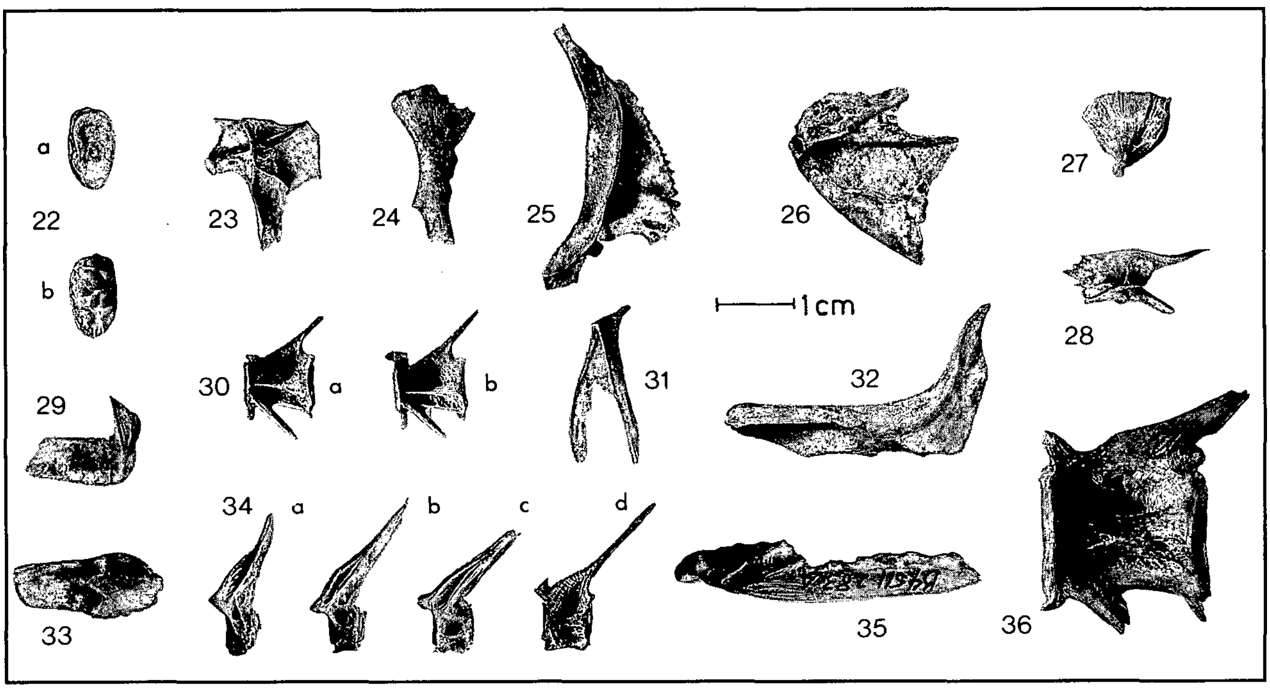


Table 9.25 Anatomical survey of the Sciaenidae finds.

SKELETAL REGION Locus Number	Anatomical Character	Measures (in mm)	Total Length (*ca.* cm)
CRANIUM		Maximal Diameter	
D.3:226.57c	Broken neurocranium: ectethmoidea, sphenotica, pterotica, epioticum, opistooticum, supraoccipitale, exoccipitalia, basioccipitale	-	30
D.3:226.57c	Statolith	11	30
D.3:226.57c	Hyomandibulare dext.	17.3+	30
D.3:226.57c	Hyomandibulare sin.	20	30
D.3:226.57c	Quadratum dext.	12	30
D.3:226.57c	Quadratum sin.	12	30
D.3:226.57c	Epihyale dext.	11.1	30
D.3:226.57c	Epihyale sin.	11.3	30
D.3:226.57c	Keratohyale sin.	21	30
D.3:226.57c	Hypohale sin.	8.2	30
D.3:226.57c	Praeoperculare dext.	24.7+	30
D.3:226.57c	Praeoperculare sin.	34.6	30
D.3:226.57c	Operculare dext.	25	30
D.3:226.57c	Operculare sin.	26	30
D.3:226.57c	Interoperculare dext.	21.8	30
D.3:226.57c	Interoperculare sin.	20.7	30
D.3:226.57c	Suboperculare sin.	15+	30
D.3:226.57c	Branchiostegale	32.5	30
D.3:226.57c	Branchiostegale	21+	30
D.3:226.57c	Branchiostegale	21+ & 26.5+	30
D.3:226.57c	Pharyngobranchiale	9.3	30
D.3:226.57c	Epibranchiale dext.	11+	30
D.3:226.57c	Epibranchiale dext.	9	30
D.3:226.57c	Keratobranchiale	22	30
D.3:226.57c	Keratobranchiale	22.2	30
D.3:226.57c	Keratobranchiale	22.5	30
D.3:226.57c	Keratobranchiale	22.7	30
D.3:226.57c	Keratobranchiale	23	30
D.3:226.57c	Keratobranchiale	11+ & 13+	30
D.3:226.57c	Branchiale V dext.	18	30
D.3:226.57c	Hypobranchiale sin.	8.6	30
D.3:226.57c	Hypobranchiale I sin.	10.6	30
D.3:226.57c	Hypobranchiale dext.	10	30
D.3:226.57c	Urohyale	21	30
BODY REGION		Medioventral length	
Columna vertebralis		of corpus vert.	
D.3:226.57c	Vertebra praecaudalis (II)	3.8	30
D.3:226.57c	Vertebra praecaudalis	4.1	30
D.3:226.57c	Vertebra praecaudalis	4.9	30
D.3:226.57c	Vertebra praecaudalis	6.3	30
D.3:226.57c	Vertebra praecaudalis/caudalis	7.9	30
		Lateral length of corpus vert.	
D.3:226.57c	Vertebra caudalis	8.1	30
D.3:226.57c	Vertebra caudalis.	9	30
D.3:226.57c	Vertebra caudalis	9	30
D.3:226.57c	Vertebra caudalis	9	30
		Maximum Diameter	
D.3:226.57c	Costa	17.5	30
D.3:226.57c	Costa	17.5	30
D.3:226.57c	Costa	18+	30
D.3:226.57c	Costa	22.2	30
D.3:226.57c	Costa	11+ & 20+	30
Unpaired fins			
D.3:226.57c	Pterygiophorus	20.1+	30
D.3:226.57c	Lepidotrich	18+	30
D.3:226.57c	Lepidotrich	20+	30
Zonoskeleton and paired fins			
D.3:226.57c	Posttemporale dext.	19	30
D.3:226.57c	Supracleithrale dext.	20.3	30
D.3:226.57c	Cleithrum dext.	25+ & 21.5+	30
D.3:226.57c	Cleithrum sin.	38.5	30
D.3:226.57c	Coracoideum dext.	13.3+	30
D.3:226.57c	Spina pinnae abdominalis dext.	11.2	30
D.3:226.57c	Spina pinnae abdominalis sin.	14.2	30
OTHER BONES			
D.3:239.57c	Vertebra praecaudalis	6.4	30
D.3:239.57c	Vertebra caudalis	8.5	30
D.3:241.57d	Vertebra caudalis	9	30
D.3:241.57d	Vertebra caudalis	9.5	30
C.6:718	vertebra praecaudalis ant.	6	40
B.4:511.283a	Supracleithrale sin.	40	60
C.1:429.13	Vertebra praecaudalis/caudalis	21(m.v.1)	90-100
C.2:427	Vertebra caudalis	21.3(1.1)	90-100

67 bones, including:
3 branchiostegals, 14 branchials, 5 ribs, 1 pterygiophore, 2 lepidotrichs, 2 actinotrichs

habits, the species can be caught only in single specimens with baited hook or by underwater spearing.

Occurrence at Tell Hesban and Dispersal of Finds

The stone bass must be taken to Tell Hesban from the Mediterranean only occasionally.

The latter 2 vertebrae are so alike in their appearance and size that they obviously belong to the same serranid individual, despite their occurrence in 2 different areas: G.12 and C.5.

Preservation

The osseous substance, especially of the vertebral finds, is very firm. These fish seem not to have been salted. They probably came from heads cut off in the process of preparing food. The vertebrae found are nearest to the cranium. More anterior parts of these heads have perhaps been devoured by the scavenging canids.

Zoogeographical, Ecological, and Economical Remarks

Species of this genus are worldwide distributed in the warmer parts of oceans. They occur both in the Mediterranean and in the Red Sea. The stone bass species of these large basses have solitary habits and prefer rocky ground leaving them well protective hiding places. They prey on other fish. As most of the basses, the species of *Epinephelus* have a tasty meat.

Occurrence at Tell Hesban

As good foodfish, they may have been imported occasionally from the seacoasts. Probably they came, like the stone bass, from the Mediterranean side where, according to Bodenheimer (1935), some of the species of this genus are caught.

Family Sciaenidae, Drums and Croakers; *Johnius hololepidotus* (Lacépède), Meagers

Taxonomical Remarks

There are 67 bone units among the fish finds from Tell Hesban that have been identified as remains of the Sciaenid fish (table 9.25). All of the finds from Locus D.3:226.57c come from one individual. Those from Loci D.3:239.57c and D.3:241.57d probably also belong to that individual. Finds from Loci C.6:718 and B.4:511.283a belong to a somewhat larger fish. Those from C.1:429.13 and C.2:427 are giant specimens.

Compared with recent material of *Johnius hololepidotus,* these Sciaenid finds agree very well with the corresponding parts of it (pls. 9.22-9.36; see also fig. 5.43). On the contrary, they differ from the skeleton of a recent *Sciaena umbrina* in the collections of the Natural History Museum in Gothenburg (GNM). According to Bodenheimer (1935), the meager is a very commonly caught fish on the Mediterranean coast of Palestine, especially from December to March.

Stratigraphic Survey of Finds

The bone finds are presented stratigraphically in table 9.26. Finds of sciaenid fish are not known from Areas A, F, or G.

Table 9.26 Stratigraphic survey of the Sciaenidae finds.

Square Number	Total Length (*ca.* cm)	Anatomical Character & Code	Number of bones	Number of individuals
B.4	60	1(0:1) supracleith. (511.283.A8)	1	1
C.1	90-100	Vert. praecaud./caudalis (429.13)	1	1
C.2	90-100	Vert. caudalis (427)	1	1
C.6	40	Vert. praecaudalis (718)	1	1
D.3	30	59 bones (226.57c), 2 do. (239.57c), 2 do. (241.57d)	63	1
			67	5

Dispersal of finds

Vertebrae of the giant specimen (*ca.* 90-100 cm) from Squares C.1 and C.2 may be from the same individual. All finds from Square D.3 seem also to come from only one fish. The real distribution of the bone units and individuals is presented in table 9.27.

Preservation

Like that in the scombrid bones, the osseous substance of the two smaller fish is somewhat brittle. Perhaps these small meagers were specially treated for food storage: salted, fumed, or pickled. The remains of the 30 cm fish obviously do not come from kitchen or meal refuses. It must have been preserved under special condition (such as in some type of bowl).

The bone substance of the big fish is, in contrast to the small ones, very hard. Obviously it comes from fish brought fresh to Tell Hesban and not treated with salt or other preservation methods. The bones have suffered from mechanical destruction (perhaps by trampling). The lack of other skeletal parts from this large fish is possibly caused by scavenging canids. The damage on the praecaudal vertebra could well have been caused by gnawing. Measurements are listed in table 9.28.

Zoogeographical and Ecological Remarks

The meager inhabits the warmer parts of Eastern Atlantic and the Mediterranean. It is a predacious pelagic fish of warmer seas.

Table 9.27 Dispersal of Sciaenidae finds.

Total Length	Bones				Individuals			
(*ca.* cm)	B	C	D	Sum	B	C	D	Sum
30	-	-	63	63	-	-	1	1
40	-	1	-	1	-	1	-	1
60	1	-	-	1	1	-	-	1
90-100	-	2	-	2	-	1	-	1
Sum	1	3	63	67	1	2	1	4

Table 9.28 Sciaenidae measurements.

Bone Locus Number		Measures (in mm)		
Statolith				
	Side	Length Diam.	Width Diam.	Thickness
D.3:226.57c	-	11	6.1	4.8
Hyomandibulare				
	Side	Length of speno-pterotical articulation	Distance between the articular surfaces of proc. sphenoticus & proc. opercularis	
D.3:226.57c	dext.	14.2	15.3	
D.3:226.57c	sin.	-	15.2	
Quadratum				
	Side	Aboral lgth	Dorsal lgth	Artic. wdth
D.3:226.57c	dext.	12.1	12	4.9
D.3:226.57c	sin.	12	12.1	4.9
Epihyale				
	Side	Height		
D.3:226.57c	dext.	11.3		
Keratohyale				
	Side	Height	Dorsal lgth	Constric. Diam.
D.3:226.57c	sin.	21	11.2	4.1
Praeoperculare				
	Side	Chordal hght	Maximum lgth	
D.3:226.57c	sin.	34.6	13.1	
Operculare				
	Side	Maximum lgth	Articular wdth	
D.3:226.57c	dext.	23	4	
Interoperculare				
	Side	Length	Height	
D.3:226.57c	dext.	20.7	8.7	
Vertebra praecaudalis				
	Side	Medioventral length of corpus	Diameter (horiz × vert) of contact surfaces of corpus: cranial	caudal
D.3:226.57c	-	3.8	4.9 × 5	5.2 × 5
D.3:226.57c	-	4.1	5.5 × 4.6	6.2 × 4.5
D.3:226.57c	-	4.9	6 × 4.9	6.2 × 5
D.3:226.57c	-	6.3	6 × 5	5.8 × 5.2
D.3:226.57c	-	6.4	7 × 5.5	6.5 × 6
Vertebra caudalis				
	Side	Lateral length of corpus		
D.3:226.57c	-	8.1	5.6 × 5.6	5.6 × 5.6
D.3:226.57c	-	9	5.1 × 5.4	5.1 × 5.3
D.3:226.57c	-	9	5.2 × 5.3	5.5 × 5.5
D.3:226.57c	-	9	5.5 × 5.5	5.6 × 5.6
D.3:239.57c	-	8.5	5.4 × 5.8	5.6 × 5.9
D.3:241.57d	-	9.5	6 × 6	6 × 6.1
D.3:241.57d	-	9	4.6 × 5	4.9 × 5.1
C.2:247	-	21	16 × 15.6	15.3 × 15
Posttemporale				
	Side	Length		
D.3:226.57c	dext.	19		
Supracleithrale				
	Side	Length	Maximum height of corpus	
D.3:226.57a	dext.	20.3	4	
B.4:511.283a	sin.	40	-	
Cleithrum				
	Side	Chordal height	Length (diameter) Dorsocaudal	Ventrocaudal
D.3:226.57c	sin.	38.5	20.2	35

Economical Remarks

Meat of the meager is very valued. According to Bodenheimer (1935), this species was a very important catch on the Mediterranean coast of Palestine: "10% of the normal local catch." Sciaenids occur in schools in shorewaters above sandy ground. They can be caught by netting, angling, or spearing.

Occurrence at Tell Hesban

As a valued food fish, the meager must have been brought to Tell Hesban from the western coast much more often than its few finds bear witness to. The MNI of only three individuals must be strongly under-representive of the number of fish of this species really consumed in the place. This is indicated by the heavy loss of skeletal parts and marks of biological destruction.

Family Sparidae, Sea Breams

This includes *Sparus auratus* (Linné), gilthead.

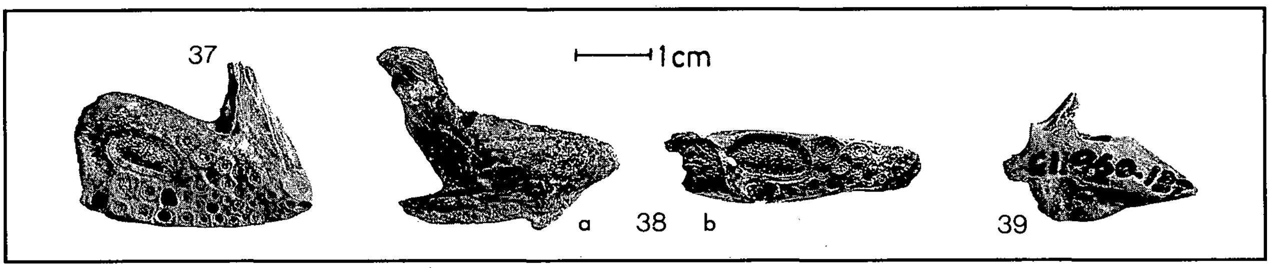
Taxonomical Remarks

There are 11 jawbones with characteristic form and typical pattern of molaroid teeth (the last molaroid of the inner series greatly exceeding the others with its size) in the material (pls. 9.37-9.39). They agree very well with recent gilthead in these features (see fig. 5.44). Much indicates that the remains should be derived from this Mediterranean species. There are, however, other species of this genus even in the Red Sea of which comparative material for this investigation was not available. The specific differences seem to be very indistinctive for the actual parts of the skeleton. In the Mediterranean, this fish has been a very important and valued catch since antiquity. Anatomical and stratigraphic surveys of the finds are presented in tables 9.29 and 9.30. Sparidae are not known from Areas A, F, or G.

Dispersal of Finds

There is no evidence for a dispersal of parts from the same individual skeleton outside an archaeological area, scarcely even for displacement in several squares of a single area. However, the finds are too few to state the last quite positively. Summing up the finds of different squares of each area, the distribution of bone units and individuals are found in tables 9.31 and 9.32.

Plates 9.37-9.39 All Sparidae finds are *Sparus auratus*: **37)** Praemaxillare sin. (D.4:138.4), n. medialis; **38)** Dentale dext. (B.2:251.13), 38a) n. lateralis, 38b) n. dorsalis; **39)** Articulare dext. (C.1:950.139), n. lateralis.



Preservation

The osseous substance of the finds is firm. In the dental from Square B.2 it has markedly been carbonized, while in the dental from Square C.1, only slightly. Irrespective to the firmness of the bone substance, the thinner parts are often broken off (possibly by trampling). It must be stressed that only the mechanically most resistant parts of the skeleton, predominantly those with hard molaroid teeth, have been preserved. Obviously, besides the mechanical destruction, the biological (scavenging animals) seems to have played a very important taphonomical role. Measurements are given in table 9.33.

Table 9.29 Anatomical survey of the Sparidae finds.

Locus Number	Anatomical Character	Measures (in mm)	Total Length (*ca.* cm)
		Maximal Diameter	
C.1:136	Praemaxillare dext.	24	35
C.1:951.137	Praemaxillare dext.	27	40
C.5:531.231	Praemaxillare dext.	24	35
C.1:123	Praemaxillare sin.	28	40
D.4:138	Praemaxillare sin.	31.5	45
C.1:950.139	Articulare dext.	26.4	40
B.2:251.13	Dentale dext.	34.3	45
C.1:123	Dentale dext.	29	40
C.1:124	Dentale dext.	25.8+	35
C.1:952.140	Dentale sin.	31.5	40
C.6:4	Dentale sin.	26	35
		11 bone units; all from jawbones	

Zoogeographical Remarks

Sparus aurata is distributed in the warmer parts of Eastern Atlantic and the Mediterranean Sea. According to Bodenheimer (1935), it occurs on the coasts of Palestine in winter time. Other species of the genus are distributed in Western Atlantic, Pacific, and Indian Oceans, even entering the Red Sea.

Ecological and Economical Remarks

The gilthead is a malacophagous fish of the seaweed zone on both rocky and sandy grounds. Its meat has been highly valued since the classical times. This fish can be taken both by nets and by angling.

Occurrence at Tell Hesban

In spite of the heavy loss of most skeletal parts, the MNI estimated by finds seems to be quite realistic. The toothed jawbones are very resistant to

Table 9.30 Stratigaraphic survey of the Sparidae finds.

Square Number	Total Length (*ca.* cm)	Anatomical Character & Code	Number of: bones	individuals
B.2	45	1(1:0) dentale	1	1
C.1	35	1(1:0) praemaxillare (136), 1(1:0), dentale (124)	1	1
	40	1(1:0) praemaxillare (951.137), 1(0:1) do. (123), 1(1:0) articulare (950.139), *1(1:0) dentale* (123), 1(0:1) do. (952.140)	5	1
C.5	35	1(1:0) praemaxillare (531.231)	1	1
C.6	35	1(0:1) dentale (4)	1	1
D.4	45	1(0:1) praemaxillare	1	1
			10	6

Table 9.31 Dispersal of Sparidae finds.

Total Length (*ca.* cm)	Bones B	C	D	Sum	Individuals B	C	D	Sum
35	-	4	-	4	-	2	-	2
40	-	5	-	5	-	1	-	1
45	1	-	1	2	1	-	1	2
Sum	1	9	1	11	1	3	1	5

Table 9.32 Minimum number of Sparidae individuals (MNI).

The most abundant skeletal element on the same side	Size classes in cm 35	40	45	
Praemaxillare dext.	2	-	-	
Praemaxillare, artic. & dent. dext.	-	1	-	
Dentale dext., praemaxillare sin.	-	-	1	
MNI	2	1	1	Sum 5
MNI[1]=the sum of MNI from different areas				Sum 5
MNI[1]/MNI 1				

mechanical destruction and they seem to have been inedible even by the scavenging animals. It must be stressed that there is no difference between the MNI estimated morphologically for the whole of find material and the MNI[1], where the effect of dispersal is reckoned with. The gilthead seems most likely to have been used only in few numbers and occasionally to have been obtained from the western coast as a delicacy for variation in the menu.

Family Cichlidae, Combs

This includes *Tilapia galilaea* (Linné) and/or *Tilapia nilotica* (Linné) as well as *Tristramella sacra* or *Tristramella simonis*.

Taxonomical Remarks

Fifty-nine finds have been identified as Cichlid remains (table 9.34). Eighteen of these come from the cranium, 6 from the vertebral column (4 vertebrae, 1 urostyle, and 1 hypurale), 4 are ribs, 10 from the girdle skeleton (probably only 9 bone units), 13 are acanthotrichs (spines of fins), 4 pterygiophorii, and 4 lepidotrichs. Except for 1 operculare from D.2:11, the others seem to be very uniform and typical to the genus *Tilapia sensu strictu* (pls. 9.40-9.51). They probably came from the most common species of the area, the Galilean comb, *Tilapia galilaea*. Perhaps the large basipterygius from Square C.8 and the ultimate vertebra with its hypurale from Square G.12 may come from the somewhat larger *Tilapia nilotica* (see fig. 5.39).

The deviating operculare from Square D.2 shows a very acute ventral end, a protruding processus supra-articularis, and a peculiar structure of radiating ribbons beneath the articular part. This structure occurs both on the outer and the inner surfaces of the bone. This is very different from

Table 9.33 Sparidae measurements.

Bone Locus Number		Measures (in mm)		
Praemaxillare[1]	Side	Length of corpus	Max. hght of corpus	Diam. of the largest molaroid tooth
C.1:136	dext.	24	11.5	7.2 × (5) socle
C.5:531.221	dext.	24	12	7.5 × 4.5 socle
C.1:951.137	dext.	27	14	6.1 × 5.1 socle
C.1:123	sin.	28	13.5	6.1 × 4.2 crown
D.4:138	sin.	31.5	17.2	11.5 × 6 socle
Articulare	Side	Length		
C.1:950.139	-	26.4		
Dentale[2]	Side	Length	Symphyseal height	Diam. of the largest molaroid tooth
C.1:124	dext.	-	-	7.1 × 5 socle
C.6:4	sin.	26	-	8.5 × 5 socle
C.1:123	dext.	29	-	9.1 × 5.9 socle
C.1:952.140	sin.	31.5	-	9.2 × 5.2 socle
B.2:251.13	dext.	33.5	15	11.2 × 6.1 socle
The mean values[3]:				
Praemaxillare		Length	Max. hght of corpus	Diam. of the largest molaroid tooth
Tell Hesban		26.9 (n=5)	13.6 (n=5)	7.7 × 5 (n=5)
Magula Pevkakia		39.3 (n=6)	18.6 (n=10)	11.8 × 7.8 (n=12)
Dentale			Symphyseal height	Diam. of the largest molaroid tooth
Tell Hesban		30 (n=4)	15(1)	9 × 5.4 (n=5)
Magula Pevkakia		38 (n=5)	19.8 (n=3)	12.2 × 7.5 (n=7)

[1]These measurements from Tell Hesban can be compared with the corresponding ones from Magula Pevkakia in Thessaly (Neolithic and Bronze Ages), Lepsiksaar 1975: Length: 26-55(6); Height: 12.5-30(10); Diameter: 8 × 5-15.2 × 11(14).

[2]At Magula Pevkakia the corresponding measurements were as follows: Length: 34.8-41(5); Height: 15-24.3(3); Diameter: 10.3 × 6-14 × 8(7).

[3]The measurements from Tell Hesban are in average much smaller than the corresponding ones from Magula Pevkakia.

the typical opercularia of the genus *Tilapia* that I have examined so far on subfossil and recent skeletons. Beside the *Tilapia sensu strictu*, there are two other genera of Cichlids in the zoogeographical area—*Tristramella* with the species *Tristramella sacra* and *Tristramella simonis* and *Haplochromis* with the species *Haplochromis flavii-josephi*. The latter fish is too small for the subfossil finds from Tell Hesban. Unfortunately, there is no comparative material available of the species of the genus *Tristramella*. In addition to the common *Tilapia galilaea,* there are other species of this genus in Palestine. Of these, *Tilapia magdalenae* is somewhat northern (Syria and Lake Hula), and *Tilapia zillii* from the Lake Tiberias seems to be too small.

Dispersal of Finds

There is no evidence of dispersal of an individual skeleton outside an archaeological area. Displacement of parts within an area in different squares is possible.

Remains of cichlids are not known from Areas B or F. The stratigraphic survey of find-spots is presented in table 9.35. Distribution of bones and individuals in different areas is given in table 9.36, while MNI data is presented in table 9.37.

A single find is represented by: endopterygoideum, hyomandibulare, quadratum, dentale, epihyale, suboperculare, posttemporale, supracleithrale, coracoideum, and basipterygium. The following serial elements have been identified: 1 circumorbitale (lacrimale), 1 hypurale, 4 costae, 13 acanthotrichi, 4 pterygiophorii, 1 lepidotrich, and 3 caudal do. Other data is in table 9.38.

Preservation

The osseous substance of Cichlid bones is well preserved, in contrast to that of the Sciaenids (smaller specimens) and the Scombrids.

Table 9.34 Anatomical survey of the Cichlidae finds.

SKELETAL REGION Locus Number	Anatomical Character	Measures (in mm)	Total Length (*ca.* cm)
CRANIUM			
C.7:46	Parasphenoideum, damaged aboral	27.3+	30
G.12:43.13	Lacrimale (sin.)	18.7	30
G.12:43.13	Entopterygoideum	24.7	30
Undated	Hyomandibulare sin.	22	25
G.12:43.13	Quadratum sin.	18	30
G.12:9	Dentale sin.	18	25
G.12:43.13	Epihyale sin.	11	25
G.12:9	Praeoperculare dext.	32(+)	30
G.12:9	Praeoperculare sin.	23+	30
G.12:42.13	Praeoperculare sin.	42.5	30
C.8:73.34	Operculare dext.	32	30
C.8:43	Operculare dext.	25.5+	30
C.8:10.9	Operculare dext.	27+	30
C.8:22	Operculare sin.	19+	30
G.15	Operculare sin.	22+	30
D.2:396.80b	Operculare sin.: markedly different!	30	30
C.8:9	Operculare sin.	26.5+	30
C.7:69	Suboperculare sin.	19.5	30
BODY REGION			
Columna vertabralis			
		Medioventral length of corpus vert.	
D.2:140.30a	Vertebra praecaudalis IV	6	30
D.2:140.30a	Vertebra praec. (XIII)	7.5	30
D.2:140.30a	Vertebra praec. (XIII/XIV)	9.5	30
		Lateral length of corpus vert.	
D.2:140.30a	Vertebra caudalis	5.5	30
		Maximum diameter	
G.12:4(2).13	Urostyl	25	45
G.12:4(2).13	Hypurale	25.7	45
Ribs, costae			
D.2:140.30a	Costa sin.	18+	-
G.4:50.43	Costa sin.	28	-
G.12:4(2).13	Costa	40+ & 21.6+	-
G.12:4(2).13	Costa	30	-
Unpaired fins			
A.7:94	Spina pinnae dorsalis	30.2	-
C.4:35	Spina pinnae dorsalis	35	-
C.7:47	Spina pinnae dorsalis	31.2	-
C.8:11	Spina pinnae dorsalis	22.7+	-
D.1:415.75	Spina pinnae dorsalis	36	-
D.2:140.30a	Spina pinnae dorsalis	32.5	-
G.4:49	Spina pinnae dorsalis	44	-
G.12:4(2).13	Spina pinnae dorsalis	15+	-
G.12:4(2).13	Spina pinnae dorsalis	28.5	-
G.12:4(2).13	Spina pinnae dorsalis	33.3	-
G.12:4(2).13	Spina pinnae dorsalis	44	-
G.15:1(G.4:34)	Spina pinnae impar.	18+	-
D.2:140.30a	Pterygiophorus	20.5+	-
G.12:9	Pterygiophorus	24.5	-
G.12:9	Pterygiophorus	26.5	-
G.12:4(2).13	Pterygiophorus	20	-
G.12:4(2).13	Lepidotrich	28+	-
G.12:4(2)13	Lepidotrich p. caudalis	30+	-
G.12:4(2)13	Lepidotrich p. caudalis	29.3+	-
G.12:4(2)13	Lepidotrich p. caudalis	32+	-
Zonoskeleton and paired fins			
C.6:21	Posttemporale dext.	21.5	30
C.12:41.13	Supracleithrale dext.	23	30
C.8:43	Cleithrum dext., ventral part	25+	30
C.8:58.22	Cleithrum dext., dorsal part	25+	30
G.12:9	Cleithrum dext.	36+ & 32+	30
G.2:41.13	Cleithrum dext.	40+	30
G.12:4(7).13	Cleithrum dext.	41	25
G.15:(G.4:31)	Cleithrum dext.	53+	30
G.12:9	Coracoideum dext.	27	45
C.8:17	Basipterygium	17+ & 48+	50?
G.12:4(2).13	Spina p. pectoralis	33.5	-

Sum: 34; 4 pterygiophori, 13 acanthotrichi, 4 lepidotrichi, and 4 costae

Plates 9.40-9.51 All Cichlidae finds are *Tilapia* sp. (except as noted): **40)** Praeoperculare sin. (G.12:43.13), n. medialis; **41)** Cleithrum dext. (G.12:41.13), n. lateralis; **42)** Operculare dext. (C.8:73.34), n. medialis; **43)** Hyomandibulare sin. (undated), n. lateralis; **44)** Dentale sin. (G.12:9), n. lateralis; **45)** Posttemporale dext. (C.6:21), n. lateralis; **46)** Suboperculare sin. (C.7:69), n. lateralis; **47)** *Tristramella* sp., Operculare sin. (D.2:396.80b), n. medialis; **48)** Vertebra praecaudalis (D.2:140.30a), n. lateralis sin.; **49)** Spina pinnae dorsalis (C.4:35), n. cranialis; **50)** Vertebra caudalis (D.2:140.30a), n. lateralis sin.; **51)** Vertebra praecaudalis (D.2:140.30a), n. lateralis sin.

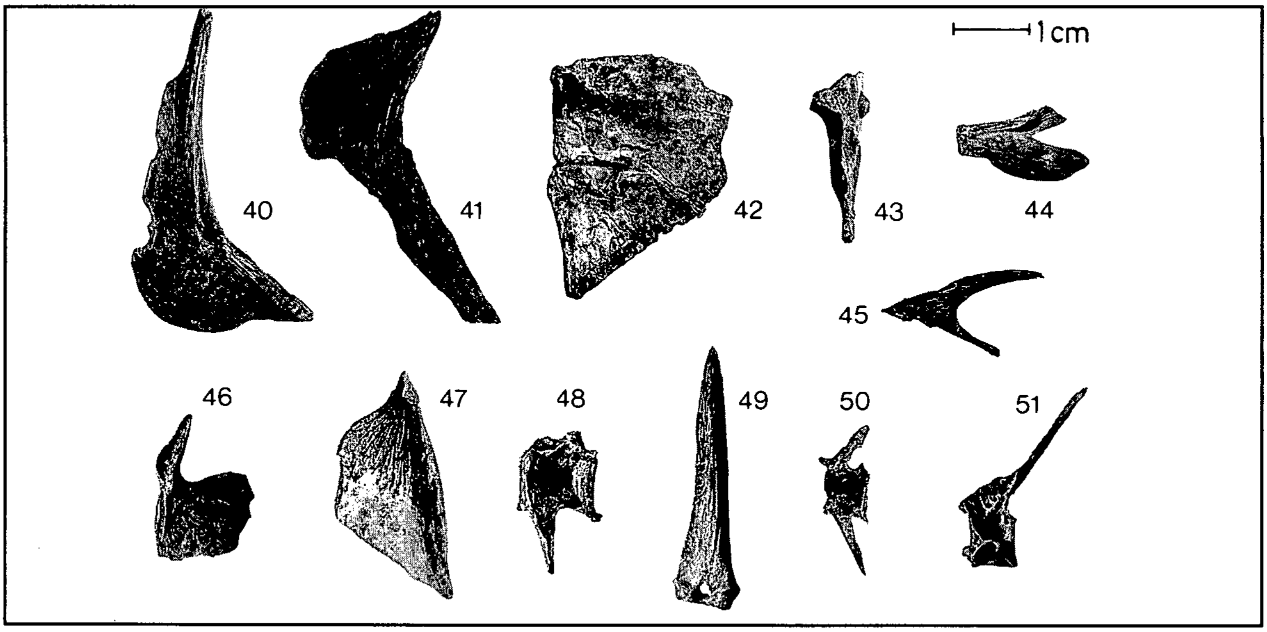


Table 9.35 Stratigraphic survey of the Cichlidae finds.

Square Number	Total Length (*ca*. cm)	Anatomical Character & Code	Number of bones	Number of individuals
A.7	?	Spina p. dorsalis (94)	(1)	1
C.4	?	Spina p. dorsalis (35)	(1)	1
C.6	25-35	1(1:0) posttemporale (21)	1	1
C.7	25-35	Paraspenoideum (46), 1(0:1) suboperculare (69)	2	1
	?	Spina p. dorsalis (47)	(1)	-
C.8	25-35	1(1:0) operculare (7.3.34), 1(1:0) do. (43), 1(1:0) do. (10.9), 1(0:1) do. (9), 1(0:1) do. (E 22), 1(1:0) cleithrum (43), 1(1:0) do. ventral; part to the former? (58.22)	6	3
	45-50	Basipterygium (17)	1	1
	?	Spina p. dorsalis (11)	(1)	-
D.1	?	Spina p. dorsalis (N 415.75)	(1)	1
D.2	25-35	1(0:1) operculare (396.80B), vertebra praecaudalis IV(140.30a), do. XIII (do.), do. XIII/XIV (do.), do. caudalis (do.)	5	2
	?	Costa (140.30a), spina p. dorsalis (do.), pterygiophorus (do.)	(3)	-
G.4	?	Costa (50.43), spina p. dorsalis (49)	(2)	1
G.12	25-35	Lacrimale (43.13), endopterygoideum (do.), 1(0:1) quadratum (do.), 1(0:1) dentale (9), 1(0:1) epihyale (43.13), 2(1:1) praeoperculare (9), 1(0:1) do. (43.13), 1(1:0) supracleithrale (41.13), 1(1:0) cleithrum (9), 2(2:0) do. (41.13), 1(1:0) coracoideum (9)	13	4
	45-50	Urostyl (42.13), hypurale (do.)	2	1
	?	2 costae (42.13), 4 spinae p. dorsalis (do.), 2 pterygiophori (9), 1 do. (42.13), 1 lepid. (do.), 3 caudal lepid. (do.), 1 spina p. pectoralis (do.)	(14)	-
G.15	25-35	1(0:1) operculare, 1(1:0) cleithrum	2	1
	?	Spina p. imp.	(1)	-
Undated	25-35	1(0:1) hyomandibulare	1	-
			33	18

Obviously, these freshwater fish have come from nearby waters and did not need to be preserved by special treatments (salting, fuming) for a long distance transport in a hot climate.

Even here, a mechanical destruction of thinner parts is obvious. The heavy loss among cichlid remains, however, is certainly due to the biological destruction by the scavenging animals. It must be stressed that there are no cerebral cases among the finds, but plenty of stinging actinotrichs (the spines of the dorsal fin of these fish are called "combs").

As is usual on the find localities with heavy biological destruction, the outer and loosely attached bones such as opercularia and cleithra are the most frequent among the find material. They easily fall off and thus come to be protected by the soil from the scavengers' attacks.

Zoogeographical Remarks

Tilapia galilaea is distributed from the Jordan westward over the whole of East and Central Africa to Liberia (Sterba 1963). According to Bodenheimer (1935), this is the most common species in fresh waters of the Palestine, including the lakes of Hula and Tiberias, as well as the Jordan River system.

Table 9.36 Dispersal of the Cichlidae finds.

Total Length (*ca.* cm)	?	A	Bones C	D	G	Sum	Individuals A	C	D	G	Sum
25-35	1	-	10	5	15	31	1	3	2	4	10
45-50	-	-	1	-	2	3	-	1	-	1	2
unknown	-	1	3	4	17	25	-	-	-	-	-
	1	1	14	9	34	59	1	4	2	5	12

Table 9.37 Minimum number of Cichlidae individuals (MNI).

The most abundant skeletal element on the same side	Size classes in cm 25-35	45-50	
Cleithrum dext.	5-6	-	
Urostyle, hypurale, basipterygium (1 find)	-	1	
MNI	5-6	1	Sum 6-7
MNI' = the sum of MNI in different areas			Sum 12
MNI/MNI' 1.7-2			

Tilapia nilotica is distributed from Syria to Egypt, East and West Africa. *Tristramella sacra* (*Paratilapia s.*) is found in Lake Tiberias and the Jordan River like the *Tristramella simonis*. The latter has also occurred in the Hula Lake.

Table 9.38 Cichlidae: 1) Frequency, 2) Symmetry of the Sides, 3) Relative Representation, 4) Relative Loss. (MNI = 6.)

Skeletal Elements	1	2	3	4
Unpaired (expected 6)				
Parasphenoideum	1	-	-	-
Urostyl (Vert. caudalis ultima)	1	-	-	-
Paired (expected 12)				
Opercularia	7	3:4	58.2%	41.7%
Cleithra	5	5:0	41.7%	58.2%
Praeopercularia	3	1:2	25%	75%
Serial				
Vertebrae praecaudales (expected 15 x 6 = 90)	3	-	3.3%	96.7%
Vertebrae caudales (expected 14 x 6 = 84)	1	-	-	-

Table 9.39 Cichlidae measurements.

Bone Locus Number		Measures (in mm)		
Endopterygoideum				
	Side	Length × Width		
G.12:4(3).13	-	24.7×6		
Hyomandibulare				
	Side	Height	Distance between the articular surfaces of proc. pteroticus and proc. opercularis	
Undated	sin.	22	8	
Quadratum				
	Side	Height	Articular width	
G.12:4(3).13	sin.	18	3.7	
Dentale				
	Side	Ventral length		
G.12:9 (G.4:34)	sin.	18		
Operculare				
	Side	Oral height-diameter		
C.8:73.34	dext.	32		
D.2:396.80b	sin.	30		
Suboperculare				
	Side	Oral height		
C.7:69	sin.	19.5		
Vertebra praecaudalis				
	Side	Medioventral Length of corpus vertebrae	ID (hor. × vert.) of corpus vertebrae cranial	caudal
D.2:140.30a	(IV)	6	6.9×6.8	6.2×6.7
D.2:140.30a	(XIII)	7.5	5.3×5.9	6×6.2
D.2:140.30a	(XIII/XIV)	9.5	8.1×6.7	7.8×7.2
Vertebra caudalis				
	Side	Lateral length of corpus vertebrae	ID (hor. × vert.) of corpus vertebrae cranial	caudal
D.2:140.30a	-	(5.5)	6×5.8	5.5×5.8
Urostyl				
	Side	Length	ID (hor. × vert.) of corpus vertebrae cranial	caudal
G 12.42.13	-	25	-	-
Spina pinnae dorsalis				
	Side	Length	Basal Width	
G.12:4(2).13	-	28.5	3.7	
A.7:94	-	30.2	4.7	
C.7:47	-	31.2	5.5 (+)	
D.2:140.30 a	-	32.5	7.1	
G.12:4(2).13	-	33.3	4	
C.4:35	-	35	9	
D.1:415.75	-	36	7	
G.4:49	-	44	4	
G.12:4(2).13	-	44	5.7	
Posttemporale				
	Side	Length		
C.6:21	dext.	21.5		

Ecological and Economical Remarks

These are freshwater fish which feed on vertebrates. They are good food fish netted in large catches.

Occurrence at Tell Hesban

Due to the destruction by scavenging animals, the remains of cichlid fish are probably much underrepresented. This is indicated by the heavy selection among the skeletal parts, a strong asymmetry of the find numbers from both sides of the body, and by the fact that the MNI[1] (the sum of MNI in different areas) is nearly double of the MNI value (estimated morphologically for the whole of material without consideration of the distributional factor). The cichlids must have been easy to obtain abundantly from the Jordan River system as fresh meat. Measurements are provided in table 9.39.

Family Scaridae, Parrot fish

This includes the *Sparisoma* sp. and *Pseudoscarus* sp.

Taxonomical Remarks

Of the finds of the fish remains from Tell Hesban, 138 have been identified as hard parts of parrot fish (tables 9.40 and 9.41; pls. 9.52-9.70; see also fig. 5.47). Among them are also 1 rib, 1 lipidotrich, and a scale.

With few exceptions, the find material of Scaridae from Tell Hesban is quite uniform and can be derived from a species of the genus *Pseudoscarus*. Most typical for this genus are the finds of praemaxillae, dentals and of upper and lower pharyngeal bones.

The teeth of both jawbones are relatively fine and coalesced. They

Table 9.40 Anatomical survey of the Scaridae finds.

SKELETAL REGION Locus Number	Anatomical Character	Measures (in mm)	Total Length (*ca.* cm)
CRANIUM			
C.5:2.83	Exoccipitalia + Basioccipitale + Parasphenoideum	49.5	40
C.6:54	Parasphenoideum, intermedial part	35+	50
C.6:96.54	Frontale sin., defect.	34+	(60)
C.2:526.53	Praemaxillare dext., slightly damaged	30+	50
C.5:2.1	Praemaxillare dext.	69.8	70
C.6:27.23	Praemaxillare dext., damaged	32+	60
C.6:42.23	Praemaxillare dext., slightly damaged	39+	50
C.6:93.51	Praemaxillare dext., damaged	33+	60
C.9:65.30	Praemaxillare dext., damaged	26.6+	40
C.4:162.37	Praemaxillare sin., slightly damaged	45+	60
C.4:27.23	Praemaxillare sin., damaged	54+	50
C.5:27.34	Praemaxillare sin., slightly damaged	53+	70
C.5:274.85	Praemaxillare sin., damaged	35+	60
G.11:34	Praemaxillare sin.	41.2	40
F.41:6.4	Maxillare dext.	27.3	50
C.9:38	Hyomandibulare dext., damaged	20.5+	40
G.12:50.14	Hyomandibulare dext., damaged	44+	50
C.8:26	Hyomandibulare sin., damaged	19.1+	40
F.41:6.4	Hyomandibulare sin., damaged	42.5+	50
D.2:111.15	Quadratum dext., fragment	40.5+	60
F.41:6.4	Quadratum dext., damaged	35+	50
A.7:132	Quadratum dext., damaged	26+	50
C.2:51.15	Quadratum sin., damaged	38.2+	50
C.8:18	Quadratum sin., fragment	32+	40
C.1:613.74	Dentale dext.	42.3	60
C.5:366.134	Dentale dext., damaged	33+	70
C.6:42.23	Dentale dext., slightly damaged	41.5+	60
C.5:21.3	Dentale dext., slightly damaged	57+	70
C.7:33.21	Dentale dext., slightly damaged	28.8+	50
C.5:279.88	Dentale sin.	49.6+	70
C.6:2	Dentale sin.	42+	60
C.8:12	Dentale sin.	23	40
C.5:84	Praeoperculare dext., frag. (dorsal part)	43.2+	(50)
C.6:96.54	Praeoperculare dext., ventral part	55.4	(60)
C.8:26	Praeoperculare dext., frag. (dorsal part)	25.7+	(50)
C.5:89	Praeoperculare sin., damaged	40+	(50)
C.5:286.89	Praeoperculare sin., damaged	54.8	50
C.8:26	Praeoperculare sin., dors. & vent. frags.	39.5+	-
		28+	50
C.8:18	Praeoperculare sin., damaged	61+	60
F.41:6.4	Praeoperculare sin., slightly damaged	61+	50
C.3:108.5	Operculare dext., damaged (articular part)	50+	60
C.5:153.51	Operculare dext., fragment (oral part)	48.8+	60
F.41:6.4	Operculare sin., damaged	41.5+	50
C.5:(11)	Operculare sin., damaged	18+	(40)
C.5:153.51	Operculare sin., slightly damaged	41.5+	60
C.6:77.2	Operculare sin., damaged	44+	60
C.1:880.121	Os pharyngeum superius dext., damaged	33.5+	60
C.3:2	Os pharyngeum superius dext.	48	60
C.4:8.18	Os pharyngeum superius dext.	35.2	40
C.4:2.2	Os pharyngeum superius dext.	30+	50
C.5:8.1.19	Os pharyngeum superius dext.	50	60
C.5:8.1.21	Os pharyngeum superius dext., damaged	35+	50
C.5:18.211	Os pharyngeum superius dext.	25.5+	40
C.5:25.314	Os pharyngeum superius dext., damaged	50.5	60
C.5:151.50	Os pharyngeum superius dext.	26+	40
C.5:278.87	Os pharyngeum superius dext., damaged	46+	50
C.5:293.93	Os pharyngeum superius dext., damaged	37.5+	40
C.5:346.113	Os pharyngeum superius dext., damaged	38+	50
C.6:40.15	Os pharyngeum superius dext., damaged	36+	50
C.8:22.19	Os pharyngeum superius dext., damaged	35.5+	60
unknown	Os pharyngeum superius dext., damaged	28.6+	40
C.1:7.7	Os pharyngeum superius sin., damaged	30+	50
C.1:121	Os pharyngeum superius sin., fragment	27+	50
B.2:4.1	Os pharyngeum superius sin., damaged	49	60
C.3:133.14	Os pharyngeum superius sin., damaged	28+	40
C.4:5	Os pharyngeum superius sin., damaged	24+	40
C.4:35	Os pharyngeum superius sin., damaged	24.3+	40
C.4:240.54	Os pharyngeum superius sin., damaged	41+	50
C.5:6.1	Os pharyngeum superius sin., damaged	39.8+	50
C.5:7.2	Os pharyngeum superius sin., damaged	39.3+	40
C.5:13.3	Os pharyngeum superius sin., damaged	45.5+	60
C.5:21.3	Os pharyngeum superius sin., damaged	38.8+	60
C.5:31.104	Os pharyngeum superius sin.	52	60
C.5:280.87	Os pharyngeum superius sin., damaged	31+	40
C.5:283.89	Os pharyngeum superius sin., damaged	36+	-
C.5:293.53	Os pharyngeum superius sin., damaged	38.5+	40
C.5:326.113	Os pharyngeum superius sin., damaged	44+	60
C.6:28.16	Os pharyngeum superius sin., damaged	26+	40
C.8:12.12	Os pharyngeum superius sin., damaged	54+	70
C.8:46.26	Os pharyngeum superius sin., damaged	37+	40
D.2:24.7	Os pharyngeum superius sin., damaged	38+	60
G.11:5.4	Os pharyngeum superius sin., damaged	38+	40
unknown	Os pharyngeum superius sin., fragment	10.5+	40
unknown	Os pharyngeum superius sin., damaged	33.3+	60

Table 9.40, *continued*. Anatomical survey of Scaridae finds.

SKELETAL REGION Locus Number	Anatomical Character	Measures (in mm)	Total Length (*ca*. cm)
C.4:178	Os pharyngeum inferius	46.2	50
C.5:37.3.19	Os pharyngeum inferius	46	60
C.5:58.5.6	Os pharyngeum inferius	46.3	50
C.5:61.5.7	Os pharyngeum inferius	48.5	50
C.5:84	Os pharyngeum inferius, fragment	12.5+	-
C.5:366.134	Os pharyngeum inferius, damaged	21+	40
C.5:293.93	Os pharyngeum inferius	35+	40
C.6:28.16	Os pharyngeum inferius	59	70
C.6:47.23	Os pharyngeum inferius, damaged	28.8	50
C.7:38.10	Os pharyngeum inferius, damaged	34	50
C.7:51.15	Os pharyngeum inferius, damaged	22+	40
C.7:79.40	Os pharyngeum inferius, damaged	38.1+	50
C.8:77.35	Os pharyngeum inferius	48.2	50
C.9:36	Os pharyngeum inferius, fragment	21.8+	40
D.4:195.77	Os pharyngeum inferius, damaged	42.5+	45
G.11:5.4	Os pharyngeum inferius, damaged	27.2	40
C.8:26	Urohyale	35.2	?
C.8:28	Urohyale, damaged	29.5+	?
TRUNKUS			
C.5:88	Vertebra praecaudalis post.	12.6	60
C.7:21.76	Vertebra praecaudalis post.	11.2	60
C.9:29	Vertebra praecaudalis post.	11.2	40
C.1:?.74	Vertebra caudalis	12	50
C.1:1.1	Vertebra caudalis, damaged	13.6	50
C.3:108.5	Vertebra caudalis	15.7	60
C.4:40.15	Vertebra caudalis	10	40
C.5:21.3	Vertebra caudalis	16.2	70
C.5:87	Vertebra caudalis	16	60
C.5:87	Vertebra caudalis	12	50
C.5:94	Vertebra caudalis	12.7	50
C.5:184	Vertebra caudalis	13	60
C.6:6.42.23	Vertebra caudalis	10.6	50
C.6:43.23	Vertebra caudalis	12	50
C.6:50.15	Vertebra caudalis	17	70
C.6:58	Vertebra caudalis	13.6	60
C.6:96	Vertebra caudalis ant.	8.7	30
C.6:233	Vertebra caudalis	11.5	50
C.7:13.8	Vertebra caudalis	14	60
C.8:11	Vertebra caudalis	(34+)	50
C.8:26	Vertebra caudalis	10	40
C.9:29	Vertebra caudalis	9.6	40
D.2:140.30a	Vertebra caudalis	8.9	30
G.12:18.6	Vertebra caudalis	(22+)	50
unknown	Vertebra caudalis	11.3	50
unknown	Vertebra caudalis	11.5	50
unknown	Vertebra caudalis post., fragment	(32+)	(50)
C.9:46	Costa	47	?
ZONOSKELETON & PAIRED FINS			
C.4:364.201	Cleithrum sin., damaged	54.6+	(50)
C.5:291.93	Scapula sin., damaged	19+	(40)
unknown	Scapula sin., damaged	19+	(50)
C.5:348.113	Coracoideum dext., 5 fragments	-	(50)
C.8:3.17	Coracoideum sin.	49	50
G.11:17	Coracoideum dext.	28+	(40)
C.6:54	Lepidotrich p. pectoralis	41.7+	?
C.5:113	Lepis	24	?

occur in oblique series, of which only 1-4 teeth of a series are distinctly visible, especially on the outer side. On the cutting edge, there is a row of few rudimentary ones behind the larger marginal teeth. In the praemaxillae, 1-3 spinous conical teeth may occur on the outer side of the hindpart of the "beak."

In the dental, the dorsoposterior part is relatively long and low. The groove, entering the outer side of this bone from the inferior margin, is widely open.

The upper pharyngeals have only 2 longitudinal rows of teeth on their grinding surface. The internal row consists of broad lamilliform teeth. Alternating with the internal row is a row of reduced cuspiform teeth on the external side. The crowns of the toothlamellae of the external series are in the younger fish sinuated, and in the elder ones harmonically rounded. There are none of *Pseudoscarus* species in the Mediterranean, but several species which are difficult to distinguish osteologically are found in the Red Sea. Regarding the occurrence of conical external teeth on the beak angle of praemaxilla, the main part of the Scaridae finds from Tell Hesban may probably be derived from *Pseudoscarus harrid* (Forsk).

One of the upper pharyngeal (from C.4:2; see pl. 9.59) is very similar to the corresponding bones described above, but differs from them in having on its external side 2 alternating series of cuspiform teeth. If this, an obviously more primitive dentition, indicates another species of *Pseudoscarus* or a species of another genus, that cannot be decided yet. Compared with a recent species of genus *Callyodon,* it is very different.

The lower pharyngeals are all of a form typical for *Pseudoscarus*. The length of their dentigerous median plate is much longer than its width. The length:width ratio varies and so does the form of the dentigerous plate. Some specimens have it with the sideborders parallel, while in others they convergate markedly. The lack of recent well-identified material for comparison does not allow a decision if these differences are due to an individual variation or differences of specific value.

Besides these finds with *Pseudoscarus*-characters, there are also some of the genus *Sparisoma.* There is a praemaxillare from C.5:274.85.4 (pl. 9.56) and a dentale from C.5:279.88 (pl. 9.52a,b), apparently from the same fish, besides an upper pharyngeal from C.1:880.121 (pl. 9.60) which seems to me to belong to this genus. The praemaxilla exhibits on

Table 9.41 Stratigraphic survey of the Scaridae finds.

Square Number	Total Length (*ca.* cm)	Anatomical Character & Code	Number of bones	Number of individuals
A.7	50	1(1:0) quadratum (132.61)	1	1
B.2	60	1(0:1) os pharyng. sup. (4.1)	1	1
C.1	50	1(0:1) os pharyng. sup (7.7), 1(0:1) do. (121), vertebra caudalis (1.1), do. (74)	3	2
	60	1(1:0) dentale (613.74)	1	1
	70	1(1:0) os pharyng. sup. (W.880.131:*Sparisoma*)	1	1
C.2	50	1(1:0) praemax. (526.53), 1(0:1) quad. (51.15)	2	1
C.3	40	1(0:1) os pharyng. sup. (133.14)	1	1
	60	1(1:0) operculare (108.5), 1(1:0) os pharyng. sup. (2), vertebra caudalis (108.5)	3	1
C.4	40	1(1:0) os pharyng. sup. (8.18.3), 1(0:1) do. (5), 1(0:1) do. (53), vertebra caudalis (40.15)	4	2
	50	1(0:1) praemax. (27.23.6), 1(1:0) os pharyng. sup. (2:*Pseudoscarus* ?), 1(0:1) do. (240.54), os phar. inf. (178.97.1), 1(0:1) cleith. (364.201)	5	2
	60	1(0:1) praemaxillare (162.37)	1	1
C.5	40	occipito-parasphenoidal frag. (W.2.83), 1(0:1) operc. (11), 1(1:0) os pharyng. sup. (18.2.11), 1(1:0) do. (151.50), 1(1:0) do. (W.293.93), 1(1:1) do. (7.2), 1(0:1) do. (W.280.87), 1(0:1) do. (W.283.89), 1(0:1) do. (293.53), os pharyng. inf. (W.293.93), do. (W.366.124), 1(0:1) scapula (W.291.93), 1(1:0) coracoideum (348.43)	13	4
	50	1(1:0) praeoperc. (84), 1(0:1) do. (W.286.89), 1(1:0) os pharyng. sup. (8.1.2i), 1(1:0) do. (W.278.87), 1(1:0) do (W.346.113), 1(0:1) do. (6.1), os phar. inf. (58.5.6), do. (61.5), v. caud. (87), do. (94), 1(1:0) coracoideum (348.113)	11	3
	60	1(1:0) operculare (153), 1(0:1) do. (153.51), 1(1:0) os pharyng. sup. (8.1.19), 1(1:0) do. (25.3.4), 1(0:1) do. (21.3.16), 1(0:1) do. (13.3.7), 1(0:1) do. (W.31.g.104), 1(0:1) do. (W.326.113), os pharyng. inf. (37.3.19), v. praecaud. (88), v. caud. (87), do. (184.134)	12	4
	70	1(1:0) praemaxillare (2.1.17), 1(0:1) do. (W.274.85.4:*Sparisoma*), 1(0:1) do. (27.3.4), 1(1:0) dentale (21.3), 1(1:0) do. (W.366.134), 1(0:1) do. (W.279.88:*Sparisoma*), v. caud. (21.3.1)	7	3
	?	Os pharyng. inf. (84), scale (21.3.1)	2	-
C.6	30	Vertebra caudalis (96)	1	1
	50	Parasphenoideum (E.54), 1(1:0) praemaxillare (42.23), 1(1:0) os pharyng. sup. (40.15), os pharyng. inf. (28.16), do. (42.23), do. (43.23), vertebra caudalis (233), do. (6.42.23)	8	3
	60	1(0:1) frontale (E.96.54), 1(1:0) praemaxillare (2.27), 1(1:0) do. (E.93.51), 1(1:0) dentale (42.23), 1(0:1) do. (E.2), 1(1:0) praeoperculare (E.96.54), 1(0:1) operculare (E.77.2), vertebra caudalis (58), do. (42.23)	9	2
	70	Os pharyng. inf. (28.16), v. caud. (50.15)	2	1
	?	Lepidotrich (54)	1	1
C.7	40	Os pharyng. inf. (51.15)	1	1
	50	1(1:0) dentale (33.21), os pharyng. inf. (38.10), do. (79.40)	3	2
	60	Vertebra praecaudalis (2.1.76), do. (13.8)	2	1
C.8	40	1(0:1) dentale (12), 1(0:1) hyomandibulare (26), 1(0:1) quadratum (18), 1(0:1) os pharyng. sup. (E.46.26), vertebra caudalis (E.26), 1(0:1) coracoideum (3.17)	6	1
	50	1(1:0) praeoperculare (E.26), 1(0:1) do. (E.8.26), os pharyng. inf. (77.35), v. caud. (11)	4	1
	60	1(0:1) praeoperculare (18), 1(1:0) os pharyng. sup. (22.19)	2	1
	70	1(0:1) os pharyng. sup. (12.12)	1	1
	?	Urohyale (26), do. (28)	2	-
C.9	40	1(1:0) praemaxillare (65.30), 1(1:0) hyomandibulare (38), os pharyng. inf. (36), vertebra praecaudalis (29), vertebra caudalis (do.)	5	1
	?	Costa (46)	1	-
D.2	30	Vertebra caudalis (140.30a)	1	1
	60	1(1:0) quadratum (111.15), 1(0:1) os pharyng. sup. (24.7.53)	2	1
D.4	45	Os pharyng. inf. (195.77)	1	1
F.41	50	1(1:0) maxillare (6.4), 1(1:0) quadratum (6.4), 1(0:1) hyomandibulare (6.4), 1(0:1) praeoperculare (6.4), 1(0:1) operculare (6.4)	5	1
G.11	40	1(0:1) praemaxillare (5.4), 1(0:1) os pharyng. sup. (5.4), os pharyng. inf. (5.4), 1(1:0) coracoideum (17)	4	1
G.12	50	1(1:0) hyomandibulare (50.14), v. caud. (13.6)	2	1
unknown	40	2(1:1) os pharyng. sup.	2	-
	50	3 vertebrae caudales, 1(0:1) scapula	4	-
	60	1(0:1) os pharyng. sup.	1	-
			138	51

its external side a mosaic pattern of rounded teeth. At least 10 oblique series of up to 12 teeth are quite visible. The top tooth of each series protrudes quite freely on the cutting edge. On the inner margin of the bone, only one row of relatively coarse marginal teeth is visible.

The "beak" of the dental is strongly curved. The relatively coarse teeth of the protruded anterior part are arranged in oblique series. Besides the distinct top tooth of each series, only a few (up to four) are visible on the external, and only one on the internal side of the cutting edge.

Contrary to the outstretched form of the dorsoposterior part of the dentale in *Pseudoscarus*, in *Sparisoma*, this is much shorter and higher. The groove of the inferior part on the external side of the bone is here much narrower, greatly covered by its protruding posterior margin.

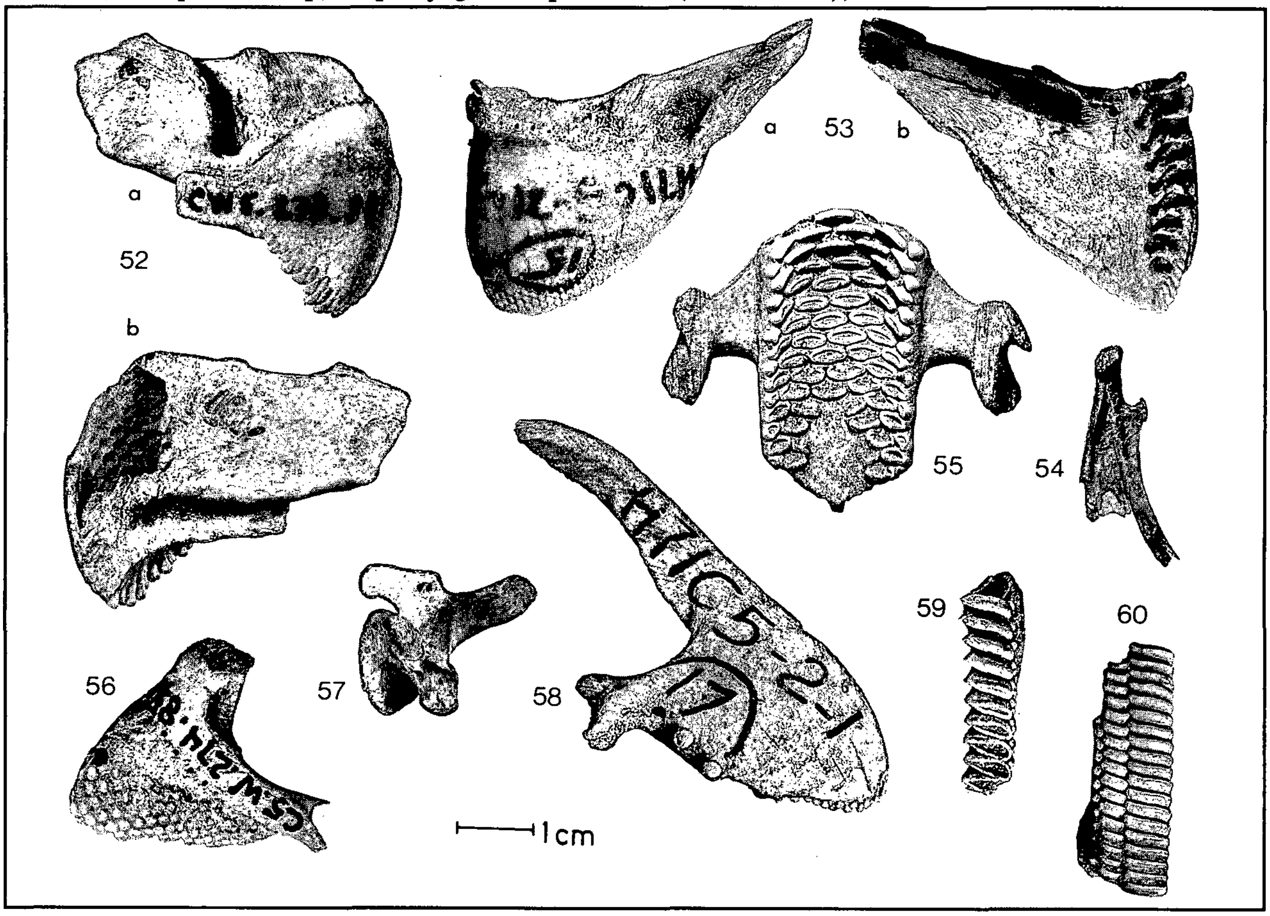
The upper pharyngeal from C.1:880.121 has with its three longitudinal series of teeth a much more primitive tooth pattern than the pharyngeals described above. The internal row is the widest of all. The external one has cuspiform teeth and the intermediate row, too, has lamelliform "crowns."

This genus occurs both in the Mediterranean and in the Red Sea. The mediterranean *Sparisoma cretense* (Linné) is said to attain only 40 cm in its total length. The total length of the *Sparisoma* represented by the above-named remains in Tell Hesban can be estimated to be *ca.* 60-70 cm, a much larger Red Sea species.

Dispersal of the Finds

There is no evidence for dispersal of an individual skeleton outside an area. Within the area, bones from one individual may be displaced in several

Plates 9.52-9.60 All Scaridae finds are *Scarus (Pseudoscarus) cf. harrid* (except as noted): **52)** *Sparisoma* sp., Dentale sin. (C.5:279.88), 52a) n. lateralis, 52b) n. medialis; **53)** Dentale dext. (C.5:21.3), 53a) n. lateralis, 53b) n. medialis; **54)** Urohyale (C.8:28), n. lateralis; **55)** Os pharyngeum inferius (C.8:77.35), n. dorsalis; **56)** Praemaxillare sin. (C.5:274.85), n. lateralis; **57)** Maxillare dext. (F.41:6.4), n. medialis; **58)** Praemaxillare dext. (C.5:2.1), n. lateralis; **59)** *Scarus* sp., Os pharyngeum superius dext. (C.4:2.2), n. ventralis; **60)** *Sparisoma* sp, Os pharyngeum superius sin. (C.1:880.121), n. ventralis.



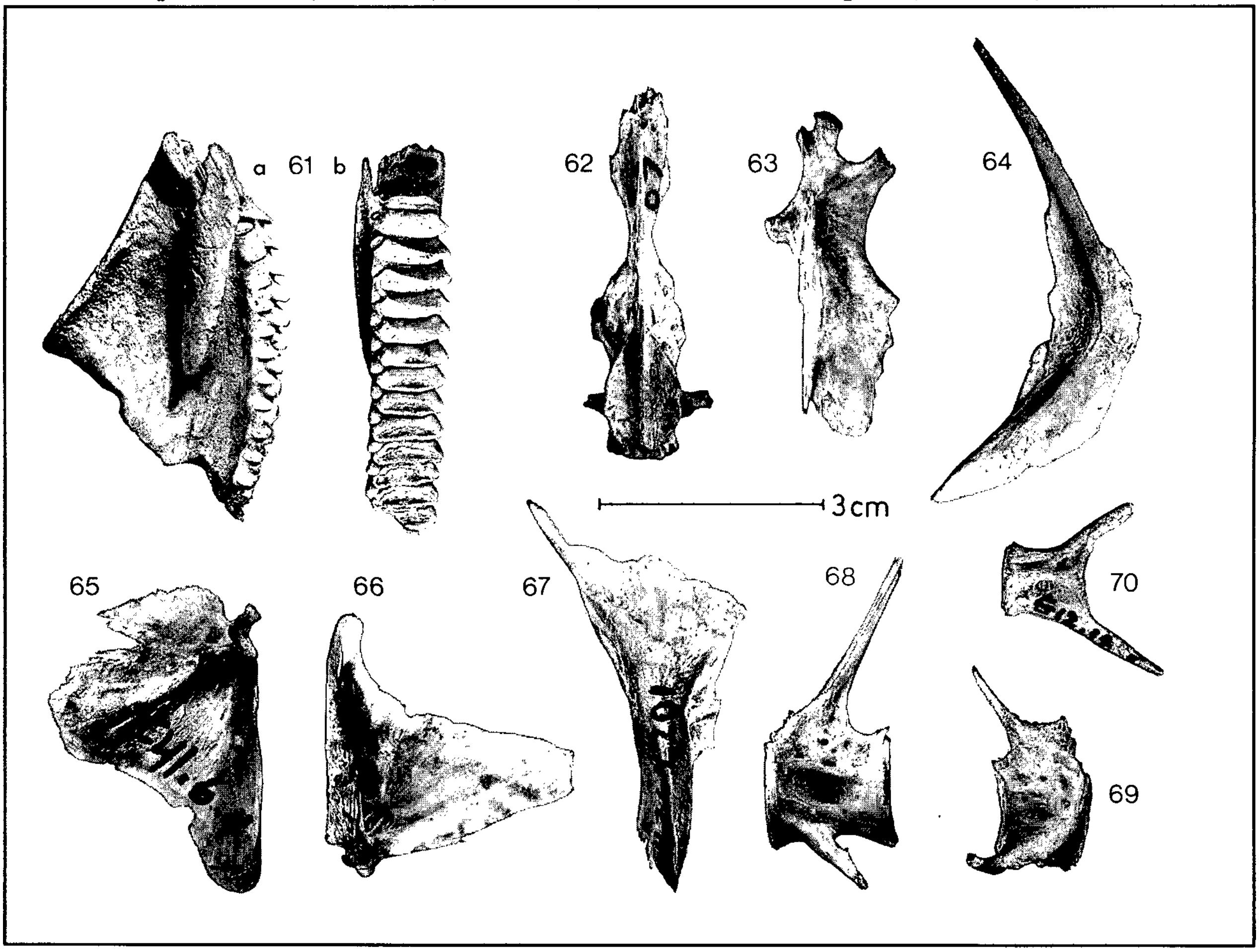
squares. Obviously all three finds of *Sparisoma* from C.1:880.121, C.5:274.85.4, and C.5:271.88 belong to the same fish.

Remains of parrot fish are known from all areas of the excavation, and most abundantly in Area C. The distribution of bones and individuals in different areas is presented in table 9.42. MNI data is given in table 9.43. Additional descriptive data is in table 9.44.

Preservation

Osseous substance in the remains of parrot fish from Tell Hesban is well preserved. There is no evidence that they were salted for the long transport from the Red Sea. They seem to have suffered much less of the mechanical destruction (perhaps trampling) than the bone remains of other fish groups in the material. The anatomical selection of skeleton elements is, however, much limited. The most frequent elements are the very hardy toothbearing jawbones and pharyngeals. There are very few vertebrae among the finds; however, the caudal ones have a representative value 6 times more than the precaudals. There is no direct evidence that the fish were decapitated before they were prepared for meals. Rather, the loss is caused by scavenging dogs. The dogs have obviously devoured the softer bones, leaving the very hardy jawbones and pharyngeals behind.

Plates 9.61-9.70 All Scaridae finds are *Scarus (Pseudoscarus) cf. harrid* (except as noted): **61)** Os pharyngeum superius dext. (C.5:31g.104), 61a) n. lateralis, 61b) n. ventralis; **62)** Parasphenoideum+Ossa occipitalia (C.5:2.83), n. ventralis; **63)** Hyomandibulare dext. (G.12:50.14), n. lateralis; **64)** Praeoperculare sin. (F.41:6.4), n. lateralis; **65)** Operculare sin. (F.41:6.4), n. medialis; **66)** Quadratum dext. (F.41:6.4), n. lateralis; **67)** Cleithrum sin. (C.4:364.201), n. lateralis; **68)** Vertebra caudalis (C.5:21.3), n. lateralis sin.; **69)** Vertebra praecaudalis (C.7:21.76), n. lateralis; **70)** Vertebra caudalis post. (G.12:18.6), n. lateralis sin.



Zoogeographical Remarks

The members of this family are limited to tropical seas. One species (*Sparisoma cretense*) inhabits the Mediterranean, especially the eastern part of this sea. As already mentioned, the parrot fish in the excavation material from Tell Hesban must have come from the Red Sea.

Ecological and Economical Remarks

Parrot fish are adapted to feeding on algae inhabiting corals. They use their strong "beaks" to browse on corals and crush these with their grinding pharyngeal teeth. The parrot fish are very good food fish—their meat praised by the gourmets of classical times.

Occurrence at Tell Hesban

From the large number of their remains (second only to the Scombrids) and their wide distribution in different areas, it follows that the parrot fish held great importance for the inhabitants of Tell Hesban. How these large fish could have been transported the long way from the Red Sea to Tell Hesban without being treated with salt is a problem of its own. Perhaps they were fumed or dried.

Table 9.42 Dispersal of the Scaridae finds.

Total Length (*ca.* cm)	Bones A	B	C	D	F	G	?	Sum	Individuals A	B	C	D	F	G	Sum
30	-	-	1	1	-	-	-	2	-	-	1	1	-	-	2
40	-	-	30	1	-	4	2	37	-	-	8	1	-	1	10
50	1	-	36	-	5	2	4	48	1	-	5	-	1	1	8
60	-	1	30	2	-	-	1	34	-	1	4	1	-	-	6
70	-	-	11	-	-	-	-	11	-	-	3	-	-	-	3
unknown	-	-	6	-	-	-	-	6	-	-	-	-	-	-	-
Sum	1	1	114	4	5	6	7	138	1	1	21	3	1	2	29

Table 9.43 Minimum number of Scaridae individuals (MNI).

The most abundant skeletal element on the same side	Size classes (*ca.* cm) 30	40	50	60	70	
Vertebrae caudales	1	-	-	-	-	
Os pharyng. sup. sin.	-	10	-	-	-	
Os pharyng. inf.	-	-	7	-	-	
Os pharyng. sup. sin.	-	-	-	7	-	
Dentale (*Pseudoscarus*: 2 dext., *Sparisoma*: 1 sin.)	-	-	-	-	3	
MNI	1	10	7	7	3	Sum 28
MNI^1=sum of MNI in different areas						Sum 29
MNI^1/MNI 1.03						

Because the jawbones and especially the pharyngeals of parrot fish are very resistant against mechanical, chemical, and biologic destruction, they may be somewhat over-represented in relation to the weaker remains of other fish groups. This resistancy of the parrot fish remains is also manifested by the fact that there scarcely exists a difference between the MNI and MNI^1. The remains found perhaps represent an initial number of *ca.* 30-40 consumed on these places.

Table 9.44 Scaridae: 1) Frequency, 2) Symmetry of the Sides, 3) Relative Representation, 4) Relative Loss.

Skeletal Elements	1	2	3	4
Unpaired (expected 28)				
Os pharyngeum inf.	16	-	57.1%	42.9%
Parasphenoideum	2	-	7.1%	92.9%
Urohyale	2	-	7.1%	92.9%
Basioccipitale	1	-	-	-
Paired (expected 56)				
Os pharyngeum sup.	38	15:23	67.9%	32.1%
Praemaxillare	11	6:5	19.6%	80.4%
Praeoperculare	9	3:6	16.1%	83.9%
Dentale	8	5:3	14.3%	85.7%
Operculare	6	2:4	10.7%	89.3%
Quadratum	5	3:2	8.9%	91.1%
Hyomandibulare	4	2:2	7.1%	92.9%
Coracoideum	3	2:1	5.4%	94.6%
Exoccipitale	2	1:1	3.6%	96.4%
Scapula	2	0:2	3.6%	96.4%
Frontale	1	-	-	-
Maxillare	1	-	-	-
Cleithrum	1	-	-	-
Serial				
Vertebrae praecaudales (expected 11×28=308)	3	-	1.0%	99%
Vertebrae caudales (expected 14x28-364)	24	-	6.6%	93.4%

Bones from C.5:27.34 and C.4:2.1.17 may be from the same individual. The find from C.5:274.85.4 is a *Sparisoma* sp.; the others apparently one or two species of *Pseudoscarus*. That of C.5:279.88 is probably a *Sparisoma* sp. and comes from the same individual as the premaxillary from C.5:274.85.4. All other dentals apparently belong to *Pseudoscarus*. The toothcrown of the juvenile *Pseudoscarus* is notched on its internal side. The density-index increases with the age of the fish. In the upper series, the sides of the dentigerous plate are nearby parallel, while in the lower ones they converge abroad. The example from C.5:37.3.9 has a very narrow dentigerous plate. Specific measurements are given in table 9.45.

Family Scombridae, Mackerels and Tunnies

This includes *Auxis thazard* (Lacépède), the frigate mackerel or the Auxide, also possibly the *Katsuwonus pelamis* (Linné), the oceanic bonito, and the *Euthynnus affinis* (Cantor).

Taxonomical Remarks

There are about 500 (485-501) anatomically identified skeletal parts and fragments (from at least 485 bone units) beside 71 lepidotrichs and 151 small unidentified pieces of bone in the Tell Hesban material which exhibit characteristics of Scombrid skeleton (tables 9.46 and 9.47; see also pls. 9.71-9.94). Of these, only very few finds are morphologically identical with the recent

Table 9.45 Scaridae measurements.

Bone Locus Number — Measures (in mm)

Praemaxillare

	Side	Length of corpus	Symphysis	Distance Dorsal notch —front end	Number of external conical teeth
C.9:65.30	dext.	18.2+	26.6	15	1(+)
G.11:34	sin.	24.3	41.2	19.4	1 rudimentary
C.5:274.85	sin.	35	31+	24	none
C.6:42.23	dext.	33.2	39	24+	1 rudimentary
C.6:93.51	dext.	31.5(+)	33+	25.5(+)	none
C.6:27.23	dext.	27.5+	32+	26(+)	1(+)
C.4:27.23	sin.	31.5	54	27.6	3
C.4:162.37	sin.	38(+)	45+	29.3	2
C.5:27.34	sin.	41.5	53+	31	2
C.5:2.1	dext.	44	69.8	33	2

Hyomandibulare

	Side	Distance between the articular sufaces of Processus pteroticus and Proc. opercularis
C.8:26	sin.	14.2
C.9:38	dext.	16
F.41:6.4	sin.	18
G.12:50.14	dext.	19

Quadratum

	Side	Articular Width	Aboral height
C.8:18	sin.	6.2+	32
F.41:6.4	dext.	7.8	35
A.7:132.61	dext.	10	19.5+
C.2:51.15	sin.	10.3	38.2+
D.2:11.15	dext.	10.2	40.5+

Dentale

	Side	Length-diameter	Symphysis	Number of symphyseal denticuli	Beak height	Beak length	Age form of the tooth
C.8:12	sin.	24.1	11	4	4.2	15.5	juv.
C.7:33.21	dext.	35.3	17.2	6	14	22	juv.
C.1:613.74	dext.	42.3	21.8	9	17.8	26.6	juv.
C.6:42.23	dext.	41.5	23	10	18	23.3	-
C.6:2	sin.	42	25.7	10	23	23.7	-
C.5:366.134	dext.	30.5+	24	10	22.8+	19.5+	-
C.5:279.88	sin.	49.6	34.5	?	29	30	-
C.5:21.3	dext.	57	32	9	26	35.5	-

Praeoperculare

	Side	Chordal height
C.5:286.89	sin.	55
F.41:6.4	sin.	60.6

Operculare

	Side	Width-diameter of Cavitas articularis
C.5:11	sin.	4
F.41:6.4	sin.	5.2
C.5:153.51	dext.	6.1
C.6:77.2	sin.	6.8
C.3:108.5	dext.	7.1
C.5:153.51	sin.	8.2

Os pharyngeum superius

	Side	Length of tooth-rows	Number of main teeth found in situ in int. row	Number of int. tooth-row in situ	Length number of teeth	*Length* width of central tooth in int. row	Crown-of the tooth	Age form
Sparisoma sp.								
C.1:880.121	dext.	33.5+	3	19	33	1.73	6	-
Pseudoscarus sp.								
C.4:2.2	dext.	30+	2-3	10	26	2.6	7	-
C.4:35	sin.	24.3+	2	10	19	1.9	4	juv.
unknown	sin.	10.5+	2	5	9	1.8	4.2	juv.
C.4:8.18	dext.	35.2	2	11	28.5	2.6	4.9	juv.
unknown	dext.	28.6	2	13	28.5	2.2	5	juv.
C.5:18.211	dext.	25.5+	2	10	25	2.5	5.2	juv.
G.11:5.4	sin.	38	2	11	28	2.8	5.3	juv.
C.4:5	sin.	24+	2	10	24	2.4	5.3	juv.
C.5:151.50	dext.	26+	2	10	21.8	2.2	5.5	juv.
C.5:293.93	dext.	37.5	2	10	28	2.8	5.5	juv.
C.5:293.93	sin.	38.5	2	10	26	2.6	5.5	juv.
C.6:28.16	sin.	26+	2	10	25.5	2.5	5.6	juv.
C.3:133.14	sin.	28+	2	11	27.5	2.5	6	juv.
C.5:280.87	sin.	31	2	11	26	2.4	6	juv.
C.8:46.26	sin.	37	2	13	29	2.2	6	juv.
C.6:40.15	dext.	36	2	12	30.5	2.5	6.5	(juv.)
C.1:121	sin.	27+	2	8	21.5	2.6	6.5	(juv.)

Table 9.45, *continued.* Scaridae measurements.

Bone / Locus Number — Measures (in mm)

Os pharyngeum superius (continued)

	Side	Length	Number of tooth-rows	Number of main teeth found in situ in int. row	Length of int. tooth-row in situ	*Length* number of teeth	Crown-width of central tooth in int. row	Age form of the tooth
Pseudoscarus sp. (continued)								
C.5:346.113	dext.	38+	2	11	32	2.9	7	-
C.1:7.7	sin.	30+	2	9	27	3	7	-
C.5:6.1	sin.	39.8+	2	14	37.5	2.7	7	-
C.4:240.54	sin.	41+	2	14	41	2.9	7	-
C.5:8.121	dext.	35+	2	13	33	2.5	7.5	-
C.5:278.87	dext.	46	2	13	36.5	2.8	7.5	-
unknown	sin.	33.3+	2	10	32	3.2	7.7	-
C.5:25.3	dext.	50.5+	2	14	39	2.8	8	-
B.2:4.1	sin.	49	2	14	41.8	3	8	-
C.5:21.3	sin.	38.8+	2	7	24.8	3.5	8.4	-
C.8:22.19	dext.	35.5+	2	6	18.5	3	8.5	-
C.5:13.3	sin.	45.5	2	14	45	3.2	8.5	-
C.3:2	dext.	48+	2	14	42.5	3	9	-
C.5:8.1	dext.	50	2	12	41	3.4	9	-
C.5:326.113	sin.	44	2	13	40	3	9	-
C.5:31g.104	sin.	52	2	15	45.5	3	9	-
D.2:24.7	sin.	38+	2	10	34	3.4	9	-
C.8:12.12	sin.	54	2	13	46	3.5	9.8	-

Os pharyngeum inferius

	Maximum		Dentigerous plate			
			Width		% of Length (length=100%)	
	width	length	oral width	aboral width	oral width	aboral width
Pseudoscarus sp.						
G.11:5.4	20.2+	27.2	17.1	16.1	63%	59%
C.7:38.10	36+	34	22	20.3	65%	60%
C.7:38.10	35+	34.1	22	20.2	64%	59%
C.8:77.35	48.2	39.6	22.2	20	56%	50%
C.5:37.3	47.1+	54	25	24.5	46%	45%
C.6:28.16	59	41	28.3	25.7	69%	63%
C.5:293.93	35+	26.5	16.1	13.2	61%	50%
C.4:78.97	46.2(+)	34	21.1	16.5	62%	48%
C.5:58.5	46.3	35.8	23.1	18.5	64%	52+
C.5:61.5	49	36.2	22	-	61%	-

Vertebrae praecaudalis

	Medioventral length of corpus vert.	Diameters (horizontal × vertical) of contact surfaces of corpus vert.	
		cranial	caudal
C.7:2.176	11	11.8 × 11.6	11.6 × 12.3
C.5:88	12.6	(11) × 10	11.5 × 10.1
C.9:29	11.2	9.1 × 8	8.3 × 7.9

Vertebrae caudales

	Lateral length of corpus vert.	Diameters (horizontal × vertical) of contact surfaces of corpus vert.	
		cranial	caudal
D.2:140.30a	8.4	6.2 × 5.7	6.1 × 5.9
C.6:96	8.5	6.2 × 6.1	6.2 × 6.2
C.8:E.26	9.2	7 × 7.1	? × 7.1
C.4:40.15	9.5	7.2 × 7	6.7 × 7
C.6:233	10.3	9.5 × 9.2	9.6 × 9.5
C.6:6.42	10.5	9 × 9.5	8 × 9.7
C.1:?74	11	9 × 8.7	8.6 × 8.5
C.?:?32	11.3	9.5 × 8.5	-
Undated	11.5	8 × 7.5	8 × 7.8
C.6:42.23	12	-	-
C.5:184.13	12.2	12 × 11	12.1 × ?
C.5:94	12	10.1 × 9.3	10.1 × 9.4
C.1:1.1	12.8	10.2 × 9.9	10 × 9.8
C.7:13.8	13.5	12.5 × ?	12.6 × 11.8
C.3:108.5	14.3	12.2 × 12.2	? × 12.6
C.5:87	14.5	13.2 × 12	13 × 12.8
C.5:21.3	15.7	15.2 × 14.4	14.6 × 13.3

comparative material of *Auxis thazard* (Lacépède) in the collections of GNM (Coll.an. 10.441): parasphenoideum (D.2:337.95b; pl. 9.74), vertebra praecaudalis V (D.4:98; pl. 9.93a,b), and vertebra praecaudalis IV (D.4:98; pl. 9.73). See fig. 5.45.

Besides these three finds, there is a neurocranial roof from D.2:337.95b which shows similarity with the corresponding part of the *Auxis*. In contrast to other neurocranial finds, there are no frontoparietal fontanelles in it and it also lacks a sharp ridge on its nuchal plane between the epiotic, opisthootics, and the exoccipitals.

Table 9.46 Anatomical survey of the Scombridae finds.

SKELETAL REGION Locus Number	Anatomical Character	Measures Maximum Diameter (in mm)	Total Length (c. cm)
CRANIUM			
D.2:376.95b	Neurocranium	63.2	50
D.2:396.80b	Neurocranium without ethmoidal part	62.7+	65
D.2:337.95b	Neurocranium: roof	51+	45
Undated	Neurocranium: fronto-occipital part	43+	62
D.2:337.95b	Neurocranium: occipital part	49.5+	50
D.2:337.95b	Neurocranium: occipital part	50+	50
D.2:337.95b	Neurocranium: occipital part	35+	50
D.2:337.95b	Neurocranium: occipital part (mainly left)	34+	47
D.2:337.95b	Neurocranium: occ. part, much damaged	23+	43
Undated	Neurocranium: otical part (left)	39+	65
D.2:337.95b	Neurocranium: occipito-otical part (right)	25.5+	50
D.2:337.95b	Neurocranium: otical part (right)	26+	50
D.2:337.95b	Neurocranium: otical part (right)	25+	50
D.2:337.95b	Neurocranium: otical part (right)	19+	50
D.2:337.95b	Neurocranium: otical part (right)	19+	50
D.2:337.95b	Neurocranium: otical part (right)	19+	50
D.2:337.95b	Neurocranium: otical part (right)	17+	50
D.2:337.95b	Neurocranium: otical part (right)	16+	50
D.2:337.95b	Neurocranium: otical part (left)	20.2+	50
D.2:87.95c	Neurocr.: parasphenoideum+occipitalia	44+	70
D.2:87.95c	Scleroticale	23+	70?
D.2:87.95c	Scleroticale	26+	70?
D.2:396.80b	Scleroticale	21.5	70?
D.2:396.80b	Scleroticale	25	70?
D.2:396.80b	Scleroticale	32	70?
Undated	Scleroticale	20	?
Undated	Scleroticale	22.5	?
Undated	Scleroticale	30	70?
Undated	Scleroticale	33	70?
D.2:337.95b	Frontale dext.	23.5+	50?
D.2:337.95b	Frontale sin.	26+	50?
D.2:337.95b	Vomer	9.2+	50
D.2:337.95b	Vomer	9.5+	50
D.2:337.95b	Vomer	11+	50
D.2:337.95b	Vomer	11+	50
D.2:337.95b	Vomer	11.7	50
D.2:337.95b	Vomer	14.5+	50
D.2:337.95b	Vomer	16.8+	50
D.2:337.95b	Vomer	10.2+	50
D.2:337.95b	Vomer	11+	50
B 7.56.5 e	Parasphenoideum	57.5+	65
D.2:337.95b	Parasphenoideum, aboral part	21+	45
D.2:337.95b	Parasphenoideum, oral and aboral damaged	35+	45
D.2:337.95b	Parasphenoideum, aboral part	16.5+	40
D.2:337.95b	Parasphenoideum, aboral part	10.5+	50
D.2:337.95b	Parasphenoideum, aboral part	15.5+	50
D.2:337.95b	Parasphenoideum, aboral part	16+	45
D.2:337.95b	Parasphenoideum, aboral part	18+	50
D.2:337.95b	Parasphenoideum, aboral part	20.5+	50
D.2:337.95b	Parasphenoideum, oral and aboral damaged	32+	50
D.2:337.95b	Parasphenoideum, oral and aboral damaged	35.5+	50
D.2:337.95b	Parasphenoideum, oral fragment	14.2+	50
D.2:337.95b	Parasphenoideum, oral fragment	18.5+	50
D.2:337.95b	Parasphenoideum, oral fragment	20.7+	50
D.2:337.95b	Parasphenoideum, oral fragment	24+	50
D.2:337.95b	Parasphenoideum, oral fragment	24+	50
D.2:87.95c	Ectethmoideum sin.	22.2	60
D.2:337.95b	Ectethmoideum dext.	14+	45
D.2:337.95b	Ectethmoideum dext.	15	45
D.2:337.95b	Ectethmoideum sin.	16	45
D.2:337.95b	Ectethmoideum dext.	14.5+	45
D.2:337.95b	Ectethmoideum dext.	15+	45
D.2:337.95b	Ectethmoideum dext.	16.1	45
D.2:337.95b	Ectethmoideum sin.	15.3+	45
D.2:337.95b	Ectethmoideum sin.	15.6+	45
Undated	Mesethmoideum+ectethmoidea	20.5	61
D.2:337.95b	Pteroticum dext.	13.2+	50
D.2:337.95b	Pteroticum dext.	13.3+	50
D.2:337.95b	Pteroticum dext.	14.2+	50
D.2:337.95b	Pteroticum dext.	15.2+	50
D.2:337.95b	Pteroticum dext.	20.5	60?
D.2:337.95b	Pteroticum sin.	13+	40
D.2:337.95b	Pteroticum sin.	14+	50
D.2:337.95b	Pteroticum sin.	14.3+	50
D.2:337.95b	Pteroticum sin.	16.5+	50
D.2:337.95b	Pteroticum sin.	16+	50?
D.2:337.95b	Pteroticum sin.	17+	50?
D.2:337.95b	Pteroticum sin.	17.3+	50
D.2:337.95b	Pteroticum sin.	17.5	50
D.2:337.95b	Pteroticum dext.	19.5+	50
D.2:337.95b	Pteroticum dext.	17.2+	50
D.2:337.95b	Sphenoticum dext.	10+	50?
D.2:337.95b	Sphenoticum dext.	11.2+	50?
D.2:337.95b	Sphenoticum dext.	12.2+	50?
D.2:337.95b	Sphenoticum dext.	12.5+	50?
D.2:337.95b	Sphenoticum dext.	12.5+	50?
D.2:337.95b	Sphenoticum dext.	13.5+	50?
D.2:337.95b	Sphenoticum dext.	-	50?
D.2:337.95b	Sphenoticum sin.	7.5+	50?
D.2:337.95b	Sphenoticum sin.	8.8+	50?
D.2:337.95b	Sphenoticum sin.	9.5+	50?
D.2:337.95b	Sphenoticum sin.	11+	50?
D.2:337.95b	Sphenoticum sin.	12+	50?
D.2:337.95b	Sphenoticum sin.	13+	50?
D.2:337.95b	Sphenoticum sin.	15.5+	50?
D.2:337.95b	Epioticum dext.	-	50?
D.2:337.95b	Epioticum dext.	-	50?
D.2:337.95b	Epioticum dext.	-	50?
D.2:337.95b	Epioticum dext.	-	50?
D.2:337.95b	Epioticum dext.	-	50?
D.2:337.95b	Epioticum dext.	-	50?
D.2:337.95b	Epioticum dext.	-	50?
D.2:337.95b	Epioticum dext.	-	50?
D.2:337.95b	Epioticum dext.	-	50?
D.2:337.95b	Epioticum dext.	-	50?
D.2:337.95b	Epioticum dext.	-	50?
D.2:337.95b	Epioticum dext.	-	50?
D.2:337.95b	Epioticum sin.	-	50?
D.2:337.95b	Epioticum sin.	-	50?
D.2:337.95b	Epioticum sin.	-	50?
D.2:337.95b	Epioticum sin.	-	50?
D.2:337.95b	Epioticum sin.	-	50?
D.2:337.95b	Epioticum sin.	-	50?
D.2:337.95b	Epioticum sin.	-	50?
D.2:337.95b	Epioticum sin.	-	50?
D.2:337.95b	Epioticum sin.	-	50?
D.2:337.95b	Prooticum sin.	10.2+	50?
D.2:337.95b	Prooticum sin.	11+	50?
D.2:337.95b	Prooticum sin.	12+	50?
D.2:337.95b	Supraoccipitale	15.5+	50?
D.2:337.95b	Supraoccipitale	19+	50?
D.2:337.95b	Supraoccipitale	19+	50?
D.2:337.95b	Basioccipitale	-	50?
D.2:337.95b	Basioccipitale	-	50?
D.2:337.95b	Basioccipitale	-	50?
D.2:337.95b	Basioccipitale	-	50?
D.2:337.95b	Basioccipitale	-	45?
D.2:337.95b	Basioccipitale	-	50?
D.2:337.95b	Basioccipitale	-	50?
D.2:337.95b	Basioccipitale	-	50?
D.2:337.95b	Exoccipitalia	11+	50?
D.2:337.95b	Exoccipitalia	17	50?
D.2:337.95b	Exoccipitale dext.	9+	50?
D.2:337.95b	Exoccipitale dext.	9.5+	50?
D.2:337.95b	Exoccipitale dext.	9.8+	50?
D.2:337.95b	Exoccipitale dext.	9.8	50?
D.2:337.95b	Exoccipitale dext.	11+	50?
D.2:337.95b	Exoccipitale dext.	11+	50?
D.2:337.95b	Exoccipitale dext.	13.5+	50?
D.2:337.95b	Exoccipitale sin.	7.5+	40?
D.2:337.95b	Exoccipitale sin.	9+	50?
D.2:337.95b	Exoccipitale sin.	10+	50?
D.2:337.95b	Exoccipitale sin.	12+	50?
D.2:337.95b	Praemaxillare dext.	15+	45?
D.2:337.95b	Praemaxillare dext.	11+/17+	45?
D.2:337.95b	Praemaxillare dext.	21+	45?
D.2:337.95b	Praemaxillare dext.	24+	50?
D.2:337.95b	Praemaxillare dext.	26+	50?
D.2:337.95b	Praemaxillare dext.	26.3+	50?
D.2:396.80b	Praemaxillare dext.	56	70
D.2:396.80b	Praemaxillare dext.	58.3	70
Undated	Praemaxillare dext.	30.2+	50
Undated	Praemaxillare dext.	36+	60
D.2:337.95b	Praemaxillare sin.	12+	50?
D.2:337.95b	Praemaxillare sin.: corpus fragment	13.2+	50?
D.2:337.95b	Praemaxillare sin.: corpus fragment	15.5+	50?
D.2:337.95b	Praemaxillare sin.	16.5+	50?
D.2:337.95b	Praemaxillare sin.	19.5+	50?
D.2:337.95b	Praemaxillare sin.	20.8+	50?
D.2:337.95b	Praemaxillare sin.	22+	50?
D.2:337.95b	Praemaxillare sin.	23+	50?
D.2:337.95b	Praemaxillare sin.	24+	50?
D.2:337.95b	Praemaxillare sin.	17.3+	50?
D.2:337.95b	Praemaxillare sin.: corpus fragment	21+	50?
D.2:396.80b	Praemaxillare sin.	57.2	70
D.4:69	Praemaxillare sin.	21+/28.5+	50
D.2:337.95b	Maxillare dext.: pars artiacularis	9+	50?
D.2:337.95b	Maxillare dext.: pars artiacularis	18.2+	50?
D.2:337.95b	Maxillare dext.: pars artiacularis	19+	50?
D.2:337.95b	Maxillare dext.: pars artiacularis	19.5+	50?
D.2:337.95b	Maxillare dext.	23+	50?
D.2:337.95b	Maxillare dext.	24.3+	50?
D.2:337.95b	Maxillare dext.	24.5+	50?
D.2:337.95b	Maxillare dext.	26.5+	50?

Table 9.46, *continued.* Anatomical survey of the Scombridae finds.

SKELETAL REGION Locus Number	Anatomical Character	Measures	
D.2:337.95b	Maxillare dext.	31.5+	50?
D.2:337.95b	Maxillare dext.	35+	50?
D.2:337.95b	Maxillare dext.	37+	50
D.2:337.95b	Maxillare dext.	18.5+	50?
D.2:337.95b	Maxillare dext.	31+	50?
D.2:396.80b	Maxillare dext.	51	70
D.2:396.80b	Maxillare dext.	47+	70
D.2:337.95b	Maxillare sin.: pars articularis	10.5+	50?
D.2:337.95b	Maxillare sin.: pars articularis	13.3+	50?
D.2:337.95b	Maxillare sin.: pars articularis	14.2+	50?
D.2:337.95b	Maxillare sin.: pars articularis	15+	50?
D.2:337.95b	Maxillare sin.	27+	50?
D.2:337.95b	Maxillare sin.	27.7+	50?
D.2:337.95b	Maxillare sin.	27.8+	50?
D.2:337.95b	Maxillare sin.	29.8+	50?
D.2:337.95b	Maxillare sin.	32.2+	50?
D.2:337.95b	Maxillare sin.	35+	50?
D.2:337.95b	Maxillare sin.	34+	50
D.2:331.95	Maxillare sin.	47.5	60
D.2:396.80b	Maxillare sin.	50.6	70
D.2:396.80b	Maxillare sin.	51	70
D.4:69	Maxillare sin.	31+	50
D.2:337.95b	Palatinum dext.	12+	50?
D.2:337.95b	Palatinum dext.	15+	50
D.2:337.95b	Palatinum dext.	15+	50
D.2:337.95b	Palatinum dext.	17+	50
D.2:337.95b	Palatinum sin.	16+	50
D.2:337.95b	Palatinum sin.	16+	50
D.4:69	Palatinum sin.	16+	50
Undated	Palatinum sin.	23.5	70
D.2:396.80b	Endopterygoideum, damaged	42+	70?
D.2:396.80b	Endopterygoideum, much damaged	47+	70?
D.4:69	Endopterygoideum; fragment	39.6+	50?
Undated	Endopterygoideum; fragment	24+	?
Undated	Metapterygoideum dext., damaged	36+	70?
Undated	Metapterygoideum + hyomandibulare sin.	35+	70?
D.2:337.95b	Hyomandibulare dext.; fragment	8+	50?
D.2:337.95b	Hyomandibulare dext.; fragment	10.8+	45?
D.2:337.95b	Hyomandibulare dext.; fragment	12.5+	50?
D.2:337.95b	Hyomandibulare dext.; fragment	13.1+	45?
D.2:337.95b	Hyomandibulare dext.	17+	45?
D.2:337.95b	Hyomandibulare dext.	17.3+	50?
D.2:337.95b	Hyomandibulare dext.	18+	50?
D.2:337.95b	Hyomandibulare dext.	21.5+	50?
D.2:337.95b	Hyomandibulare dext.	22+	50?
D.2:337.95b	Hyomandibulare dext.	18.5+	50?
D.2:337.95b	Hyomandibulare sin.	10+	50?
D.2:337.95b	Hyomandibulare sin.	13+	45?
D.2:337.95b	Hyomandibulare sin.	13.5	50?
D.2:337.95b	Hyomandibulare sin.	16+	50?
D.2:337.95b	Hyomandibulare sin.	18+	50?
D.2:337.95b	Hyomandibulare sin.	18+	50?
D.2:337.95b	Hyomandibulare sin.	22+	50?
D.2:337.95b	Hyomandibulare sin.	24+	50?
D.2:337.95b	Hyomandibulare sin.	35+	45?
D.2:337.95b	Hyomandibulare sin.	16.5+	50?
D.2:337.95b	Hyomandibulare sin.	23+	50?
D.2:396.80b	Hyomandibulare sin.	50	70
D.2:337.95b	Quadratum dext.	11+	50?
D.2:337.95b	Quadratum dext.	15+	50?
D.2:337.95b	Quadratum dext.	18+	50?
D.2:337.95b	Quadratum dext.	19+	50?
D.2:337.95b	Quadratum sin.: articular part	7.2	50?
D.2:337.95b	Quadratum sin.	17.3+	50?
D.2:337.95b	Quadratum sin.	17.6+	50?
D.2:337.95b	Quadratum sin.	18+	50?
D.2:337.95b	Quadratum sin.	20.1+	50?
D.2:337.95b	Quadratum sin.	23	50?
B.7:56	Articulare dext.	45+	70
D.2:87.95c	Articulare dext. = angulare dext.	43+	70
D.2:337.95b	Articulare dext.: articular fragment	8.2+	50?
D.2:337.95b	Articulare dext.: articular fragment	10+	50?
D.2:337.95b	Articulare dext.: articular fragment	15+	50?
D.2:337.95b	Articulare dext.: articular part	16+	50?
D.2:337.95b	Articulare dext.: articular part	17.8+	50?
D.2:337.95b	Articulare dext.: articular part	19+	50?
D.2:337.95b	Articulare dext.: articular fragment	19+	50?
D.2:337.95b	Articulare dext.: articular part	19.8+	50?
D.2:337.95b	Articulare dext.: articular part	31+	50?
D.2:337.95b	Articulare dext.: articular part	19+	50?
D.2:396.80b	Articulare dext.	61	65?
D.2:396.80b	Articulare dext.	68	70
Undated	Articulare dext.	42.5	50?
D.2:87.95c	Articulare sin. + angular sin.	45+	70
D.2:337.95b	Articulare sin.: articular fragment	18.1	50?
D.2:337.95b	Articulare sin.: articular part	19.8+	50?
D.2:337.95b	Articulare sin.: damaged	36+	50?
D.2:396.80b	Articulare sin.	64	70
D.4:69	Articulare sin.	39.3+	50?

SKELETAL REGION Locus Number	Anatomical Character	Measures	
D.2:337.95b	Dentale dext.: symphseal fragment	10.5+	50?
D.2:337.95b	Dentale dext.: symphseal fragment	12.6+	50?
D.2:337.95b	Dentale dext.: symphseal fragment	15.6+	40?
D.2:337.95b	Dentale dext.: symphseal fragment	16+	50?
D.2:337.95b	Dentale dext.: symphseal fragment	16.5+	50?
D.2:337.95b	Dentale dext.: symphseal fragment	17+	50?
D.2:337.95b	Dentale dext.: symphseal fragment	17+	50?
D.2:337.95b	Dentale dext.: symphseal fragment	18.5+	50?
D.2:337.95b	Dentale dext.: symphseal part	20.8+	50?
D.2:337.95b	Dentale dext.: symphseal part	23+	50?
D.2:337.95b	Dentale dext.: symphseal part	28+	50?
D.2:337.95b	Dentale dext.: dorsoposterius part	30.5+	50?
D.2:337.95b	Dentale dext.: anterior part	30.2+	50?
D.2:337.95b	Dentale dext.: symphseal part	31+	50?
D.2:337.95b	Dentale dext.: symphseal part	31+	50?
D.2:337.95b	Dentale dext.: anterior part	33.5+	50?
D.2:337.95b	Dentale dext.: anterior part	33.9	50?
D.2:337.95b	Dentale dext.: dorsal fragment	34.5+	50?
D.2:337.95b	Dentale dext.: anterior part	36+	50?
D.2:337.95b	Dentale dext.: anterior part	36+	-
D.2:337.95b	Dentale dext.: symphseal fragment	27+	50?
D.2:337.95b	Dentale dext.: anterior part	38.5+	50?
D.2:337.95b	Dentale dext., damaged	35+/27+	60?
D.2:396.80b	Dentale dext.	58.2+	70
D.4:69	Dentale dext.: dorsal fragment	29+	50?
D.2:337.95b	Dentale sin.: symphyseal fragment	13+	50?
D.2:337.95b	Dentale sin.: symphyseal fragment	13+	50?
D.2:337.95b	Dentale sin.: symphyseal fragment	14.1+	50?
D.2:337.95b	Dentale sin.: symphyseal fragment	15.2+	40?
D.2:337.95b	Dentale sin.: symphyseal fragment	16.5+	50?
D.2:337.95b	Dentale sin.: symphyseal fragment	17+	50?
D.2:337.95b	Dentale sin.: symphyseal fragment	18.2+	50?
D.2:337.95b	Dentale sin.: symphyseal fragment	19+	50?
D.2:337.95b	Dentale sin.: symphyseal fragment	19.8+	50?
D.2:337.95b	Dentale sin.: anterior fragment	30+	50?
D.2:337.95b	Dentale sin.: anterior fragment	35+	50?
D.2:337.95b	Dentale sin.: anterior part	37+	50?
D.2:337.95b	Dentale sin.: anterior part	34.5+	50?
D.2:337.95b	Dentale sin.: anterior part	39+	50?
D.2:337.95b	Dentale sin.: anterior part	39+	50?
D.2:87.95c	Dentale sin., damaged	35+/39+	70
D.2:396.80b	Dentale sin.	56	70
D.2:396.80b	Dentale sin.	57.5	70
Undated	Dentale sin.: anterior fragment	54.5	65?
D.2:87.95c	Epi- + keratohyale sin.	56	70
D.2:396.80b	Epi- + keratohyale sin.	57	70
D.2:337.95b	Epihyale dext.	15.2	50?
D.2:337.95b	Epihyale sin.	17.5+	50?
D.2:337.95b	Epihyale sin.	14.8+	50?
D.2:337.95b	Epihyale sin.	16.2	50?
D.2:337.95b	Epihyale sin.	17	50?
D.2:337.95b	Keratohyale dext.: ventral fragment	13.8+	50?
D.2:337.95b	Keratohyale dext.: ventral fragment	14+	50?
D.2:337.95b	Keratohyale dext.: ventral fragment	15+	50?
D.2:337.95b	Keratohyale dext.: ventral fragment	16+	50?
D.2:337.95b	Keratohyale dext.: ventral fragment	16+	50?
D.2:337.95b	Keratohyale dext.: ventral fragment	16.5+	50?
D.2:337.95b	Keratohyale dext.: ventral fragment	17+	50?
D.2:337.95b	Keratohyale dext.: ventral fragment	20+	50?
D.2:337.95b	Keratohyale dext.: ventral fragment	22.5+	50?
D.2:337.95b	Keratohyale dext.	34.5	50
D.2:337.95b	Keratohyale dext.: ventral fragment	19+	50?
D.2:337.95b	Keratohyale sin.: ventral fragment	13.5+	50?
D.2:337.95b	Keratohyale sin.: ventral fragment	14+	50?
D.2:337.95b	Keratohyale sin.: ventral fragment	15+	50?
D.2:337.95b	Keratohyale sin.: ventral fragment	16.5+	50?
D.2:337.95b	Keratohyale sin.: ventral fragment	18.3+	50?
D.2:337.95b	Keratohyale sin.: ventral fragment	20+	50?
D.2:337.95b	Keratohyale sin.: ventral fragment	20+	50?
D.2:337.95b	Keratohyale sin.: ventral fragment	21.2+	50?
D.2:337.95b	Keratohyale sin.: ventral fragment	23+	50?
D.2:337.95b	Keratohyale sin.	32.5	50?
D.4:69	Keratohyale sin.	33	50?
D.4:94	Keratohyale sin., damaged	26+	50?
D.2:337.95b	Hypohyale dext.	12+	50?
D.2:337.95b	Hypohyale dext.	12.8+	50?
D.2:337.95b	Hypohyale dext.	13.5+	50?
D.2:337.95b	Hypohyale dext.	13.5	50?
D.2:337.95b	Hypohyale dext.	15.5+	50?
D.2:337.95b	Hypohyale dext.	15+	50?
D.2:337.95b	Hypohyale dext.	16	50?
D.2:337.95b	Hypohyale dext.	16.2	50?
D.2:337.95b	Hypohyale sin.	15	50?
D.2:337.95b	Hypohyale sin.	15.2	50?
D.2:337.95b	Hypohyale sin.	15.2	50?
D.2:337.95b	Basihyale	12+	50?
D.2:337.95b	Basihyale	12.6	50
D.2:337.95b	Basihyale	14.3	55?
D.2:87.95c	Urohyale	35.5	50

Table 9.46, *continued.* Anatomical survey of the Scombridae finds.

SKELETAL REGION Locus Number	Anatomical Character	Measures	
D.2:87.95c	Urohyale	42.5	60
D.2:87.95c	Urohyale	48	65
D.2:87.95c	Praeoperculare dext.	59.5	65
D.2:337.95b	Praeoperculare dext.: dorsal fragment	16+	50?
D.2:337.95b	Praeoperculare dext.: dorsal fragment	17.5+	50?
D.2:337.95b	Praeoperculare dext.: dorsal fragment	19+	50?
D.2:337.95b	Praeoperculare dext.: ventral fragment	19.6+	50?
D.2:337.95b	Praeoperculare dext.: fragment	18.3	50?
D.2:337.95b	Praeoperculare dext.: dorsal fragment	20+	50?
D.2:337.95b	Praeoperculare dext.: dorsal fragment	20+	50?
D.2:337.95b	Praeoperculare dext.: dorsal fragment	22.5+	50?
D.2:337.95b	Praeoperculare dext.: dorsal fragment	22.5+	50?
D.2:337.95b	Praeoperculare dext.: dorsal fragment	23.5+	50?
D.2:337.95b	Praeoperculare dext.: dorsal fragment	24.5+	50?
D.2:337.95b	Praeoperculare dext.: dorsal fragment	26+	50?
D.2:337.95b	Praeoperculare dext.: dorsal fragment	26+	50?
D.2:337.95b	Praeoperculare dext.: dorsal part	26+	50
D.2:337.95b	Praeoperculare dext.: fragment	26+	50?
D.2:337.95b	Praeoperculare dext.: ventral fragment	28+	50?
D.2:337.95b	Praeoperculare dext.: dorsal fragment	31+	50?
D.2:337.95b	Praeoperculare dext., slightly damaged	34+	50?
D.2:396.80b	Praeoperculare dext., slightly damaged	62.3+	65
D.2:396.80b	Praeoperculare dext., damaged	57	60
D.4:226.94	Praeoperculare dext., slightly damaged	58	50?
Undated	Praeoperculare dext.: ventral fragment	38+	50
D.2:87.95c	Praeoperculare sin.: fragment	25.7+	60?
D.2:337.95b	Praeoperculare sin.: fragment	19+	50?
D.2:337.95b	Praeoperculare sin.: dorsal fragment	21.5+	50?
D.2:337.95b	Praeoperculare sin.: dorsal fragment	23+	50?
D.2:337.95b	Praeoperculare sin.: dorsal fragment	24+	50?
D.2:337.95b	Praeoperculare sin.: dorsal fragment	24+	50?
D.2:337.95b	Praeoperculare sin.: fragment	24.5+	50?
D.2:337.95b	Praeoperculare sin.: ventral fragment	26+	50?
D.2:337.95b	Praeoperculare sin.: ventral fragment	27.5+	50?
D.2:337.95b	Praeoperculare sin.: dorsal part	29.5+	50?
D.2:337.95b	Praeoperculare sin.: damaged	31+	50?
D.2:337.95b	Praeoperculare sin.: damaged	36+	50?
D.2:337.95b	Praeoperculare sin.: fragment	25.5+	50?
D.2:337.95b	Praeoperculare sin., damaged	45.5+	50?
D.2:396.80b	Praeoperculare sin., slightly damaged	64	70
Undated	Praoperculare sin., damaged	51	50?
D.2:87.95c	Operculare dext., damaged	54+	60
D.2:337.95b	Operculare dext.: articular fragment	9.5+	50
D.2:337.95b	Operculare dext.: articular fragment	15.5+	60
D.2:337.95b	Operculare dext.: articular fragment	18+	50
D.2:337.95b	Operculare dext.: articular fragment	20+	60
D.2:337.95b	Operculare dext.: articular fragment	21.2+	50
D.2:337.95b	Operculare dext.: articular fragment	26+	60
D.2:337.95b	Operculare dext.: articular fragment	27.5+	60
D.2:337.95b	Operculare dext., damaged	35+	50
D.2:337.95b	Operculare dext., damaged	39.8+	50?
D.4:90	Operculare dext.: articular part	23+	45
D.2:337.95b	Operculare sin.: articular fragment	10+	50
D.2:337.95b	Operculare sin.: articular fragment	11.7+	60
D.2:337.95b	Operculare sin.: articular fragment	12+	50
D.2:337.95b	Operculare sin.: articular fragment	12.2+	45?
D.2:337.95b	Operculare sin.: articular fragment	16+	40?
D.2:337.95b	Operculare sin.: articular fragment	17+	50
D.2:337.95b	Operculare sin.: articular fragment	17+	50
D.2:337.95b	Operculare sin.: articular fragment	17+	45?
D.2:337.95b	Operculare sin.: articular fragment	22+	50
D.2:337.95b	Operculare sin.: articular fragment	23+	50
D.2:337.95b	Operculare sin.: articular fragment	25.2+	50
D.2:337.95b	Operculare sin.: articular part	25.5+	50
D.2:337.95b	Operculare sin.: articular part	27.2+	50?
D.4:69	Operculare sin.: articular part	35+	50?
D.2:396.80	Interoperculare dext., damaged	61	60?
Undated	Interoperculare dext., damaged	51+	50?
D.2:376.95b	Interoperculare sin.: fragment	36+	50?
Undated	Interoperculare sin.: fragment	45+	50?
Undated	Suboperculare: fragment	34+	50?
Undated	Suboperculare: fragment	39+	50?
Undated	Suboperculare: fragment	44+	50?
BODY REGION			
Columna vertebralis			
		Medioventral length of corpus vertebrae	Total Length (*c.* cm)
D.2:87.95c	Vertebra praecaudalis I	7.2	60
D.2:337.95b	Vertebra praecaudalis I	5.1	40
D.2:337.95b	Vertebra praecaudalis I	5.5	50
D.2:337.95b	Vertebra praecaudalis II	6.5	50
D.2:337.95b	Vertebra praecaudalis III	7	50
D.2:337.95b	Vertebra praecaudalis IV	8	50
D.2:337.95b	Vertebra praecaudalis I	4.6	45
D.2:337.95b	Vertebra praecaudalis II	7	45
D.2:337.95b	Vertebra praecaudalis III	6.9	45
D.2:337.95b	Vertebra praecaudalis IV	7	45
D.2:337.95b	Vertebra praecaudalis	6.3	40?
D.2:337.95b	Vertebra praecaudalis	6.5	45
D.2:337.95b	Vertebra praecaudalis	6.5	45
D.2:337.95b	Vertebra praecaudalis	6.8	50
D.2:337.95b	Vertebra praecaudalis	6.8	50
D.2:337.95b	Vertebra praecaudalis post.	7.3	50
D.4:98	Vertebra praecaudalis V	5.8	40
D.4:98	Vertebra praecaudalis VI	6	40
		Lateral length of corp. vert (in mm)	Total Length (*c.* cm)
C.8:9	Vertebra caudalis anterior	10	60
D.2:95c	Vertebra caudalis anterior	8.5	50
D.2:337.95b	Vertebra caudalis anterior	8.5	50
D.2:337.95b	Vertebra caudalis anterior	9.2	50
D.2:337.95b	Vertebra caudalis anterior: fragment	4+	40?
C.1:373.11	V. caudalis (c. XX:w/large ventral vacs.)	11.4	60
C.1.373.16	V. caudalis (w/large ventral vacuieties)	12.1	65
C.8.26	V. caudalis post. (before the keeled ones)	12.3	65
D.2:273.43	V. caudalis post. (before the keeled ones)	10.3	60
D.2:337.95b	V. caudalis post. (before the keeled ones)	9.7	60
D.2:337.95b	V. caudalis post. (before the keeled ones)	10	60
D.2:337.95b	V. caudalis post. (with lateral keels)	12	65
D.2:337.95b	V. caudalis post. (with lateral keels)	10.8	65
D.2:337.95b	V. caudalis post. (with lateral keels)	9	65
D.2:337.95b	V. caudalis post. (with lateral keels)	6.5	45
D.2:337.95b	V. caudalis post. (with lateral keels)	6	45
D.2:337.95b	V. caudalis post. (post. to keeled ones)	2.5	45
D.2:34.95c	V. caudalis post. (w/lat. keels; last one)	7.3	60
D.4:94	V. caudalis post. (with lateral keels)	8.9	60
D.4:94	V. caudalis post. (with lateral keels)	8	60
D.4:94	Vertebra caudalis post.	4	60
		Maximum Diameter (in mm)	Total Length (*c.* cm)
A.10:16	Processus spinosus vert.	49.2+	?
B.7:37	Processus spinosus vert.	52.5+	?
B.7:37	Processus spinosus vert.	54.7+	?
D.4:69	Processus spinosus vert.	27+	?
D.4:69	Processus spinosus vert.	41.5+	?
D.4:69	Processus spinosus vert.	54+	?
D.4:69	Processus spinosus vert.	56+	?
D.4:69	Processus spinosus vert.	62.5+	?
D.4:88	Processus spinosus vert.	35+	?
D.4:94	Processus spinosus vert.	53.5+	?
D.4:94	Processus spinosus vert.	57+	?
Undated	Neurarcus: damaged	41.8	?
Unpaired fins			
		Maximum Diameter (in mm)	Total Length (*c.* cm)
D.2:337.95b	Pterygiophorus	19.3	?
C.7:47	Acanthotrich (2 bits)	22.6+/19+	?
D.2:337.95b	Acanthotrich: basal part	17.5+	?
D.2:337.95b	Acanthotrich: basal part	16.7+	-
D.2:337.95b	14 lepidotrichi: fragments	-	-
D.2:337.95b	1 caudal lepidotrich: fragment	-	-
D.4:69	2 lepidotrichi: fragments	-	-
D.4:94	2 caudal lepidotrichi: fragments	-	-
D.2:365.102	8 lepidotrichi of finlets?: fragments	-	-
D.2:365.102	Over 40 fragments of lepidotrichi	-	-
Undated	4 lepidotrichi: fragments	-	-
Zonoskeleton and paired fins			
		Maximum Diameter (in mm)	Total Length (*c.* cm)
D.2:87.95c	Posttemporale dext.	47.5	50
D.2:337.95b	Posttemporale dext.: fragment	37+	50?
D.2:337.95b	Posttemporale dext.: fragment	26.5+	50?
D.2:337.95b	Posttemporale sin.: fragment	17.2+	50?
D.2:337.95b	Posttemporale sin.: fragment	21+	50?
D.2:337.95b	Posttemporale sin.: fragment	26+	50?
D.2:337.95b	Supracleithrale sin.	19+	50
D.2:337.95b	Supracleithrale sin.	19.5+	50
Undated	Supracleithrale dext., damaged	31+	60?
D.2:337.95b	Cleithrum dext.: scapula dext.	23+	50?
D.2:337.95b	Cleithrum dext.: intermediate part	24+/21+	50?
D.2:337.95b	Cleithrum dext.: intermediate part	28.2+	50?
D.2:337.95b	Cleithrum dext.: intermediate part	39.5+	50?
D.2:337.95b	Cleithrum dext.: intermediate part	24+	50?
D.2:337.95b	Cleithrum dext.: intermediate part	32.5+	50?
D.4:207.69	Cleithrum dext.: dorsal part	25.5+	60?
D.4:207.69	Cleithrum dext.: ventral part	50.5+	60?
D.4:207.69	Cleithrum dext.: ventral part	55+	60?

Table 9.46, *continued.* Anatomical survey of the Scombridae finds.

SKELETAL REGION Locus Number	Anatomical Character	Measures	
Zonoskeleton and paired fins (continued)			
		Maximum Diameter (in mm)	Total Length (c. cm)
D.3:138.48	Cleithrum sin.: ventral part	39+	60?
D.4:69	Cleithrum sin. + scapula sin.	26+	50
D.2:337.95b	Scapula sin.	17.5+	50?
D.4:69	Spina pinnae pectoralis	21	?
Anatomically unidentified fragments			
		Maximum Diameter (in mm)	Total Length (c. cm)
D.2:87.95c	*ca.* 30 fragments	49+/small	?
D.2:337.95b	*ca.* 40 fragments	small	?
D.2:337.95b	*ca.* 18 fragments	35-30+/small	?
D.2:396.80	4 fragments	32-14+	?
D.4:69	12 fragments	27-17+	?
D.4:102	1 fragment	29+	?
Undated	*ca.* 46 fragments	36.5-26+/small	?

The main bulk of the Scrombrid remains from Tell Hesban seems to come from two other species of smaller tunnies. There is a size difference accompanied with morphological ones between these forms. The total length of the smaller species seems to vary between 40-50 cm, and that of the bigger one between 60-70 cm. Generally, they show an unmistakable morphologic affinity both between themselves and also with the *Auxis*, differing from the form both of *Thunnus* and of *Sarda*. All three forms may be species of the subfamily of *Katsuwoninae*.

The most remarkable differences in the form of *Auxis thazard* are as follows: the cranial roof has large (somewhat varying) frontoparietal fontanelles and the vomer of the smaller form (there are none from the larger one) is provided with a well developed median ridge on its ventral side bearing spurs of small teeth.

The parasphenoidea are not compressed medioventrally on their aboral part. In the smaller species, the aboral part behind the transversal processus of the bone is separated by a distinct and sharp transversal ridge from the medioventrally keeled part before them. The passage between these parts is not as sharp in the larger form. The aboral part of the smaller species is markedly compressed dorsoventrally, with sharp lateral angles and the compressed myodome opening directed ventrally. The aboral part of the larger form is cylindrical and the myodome opens caudoventrally. The anterior part of the parasphenoideum is much more slender and less dilated anteriorly in the larger species than in the smaller one.

The praemaxillae of both the smaller and the larger species are less curved laterally than in the *Auxis*. The lower end of the symphysis, especially in the larger form, is much more protruding than in the *Auxis*. The teeth seem in the smaller species to be somewhat coarser than in the larger form.

In the dentals, the upper toothed edge in both species from Tell Hesban is much straighter than in the *Auxis*. The symphysis is medially less curved. The symphysis seems even to be relatively stronger than in the *Auxis*.

In the vertebrae, the corpus vertebrae is much shorter than in the *Auxis*. In the precaudal ones, the pits of the corpus vertebrae are much shorter.

Unfortunately, the recent comparative material of other Scombrids than *Thunnus*, *Sarda*, and *Auxis* has not been available. According to the publication of H. Steinitz and A. Ben-Tuvia (1955) on the fish of the Gulf of Aqaba in the Red Sea, there are big catches of two Scombrids in size classes corresponding to the finds from Tell Hesban. Probably the latter are identical with these recent species. It is likely that the larger form in Tell Hesban is *Katsuwonus pelamis* (Linné), the oceanic bonito (see fig. 5.46), and the smaller one identical with the *Euthynnus affinis* (Cantor) of Steinitz and Ben-Tuvia (1955).

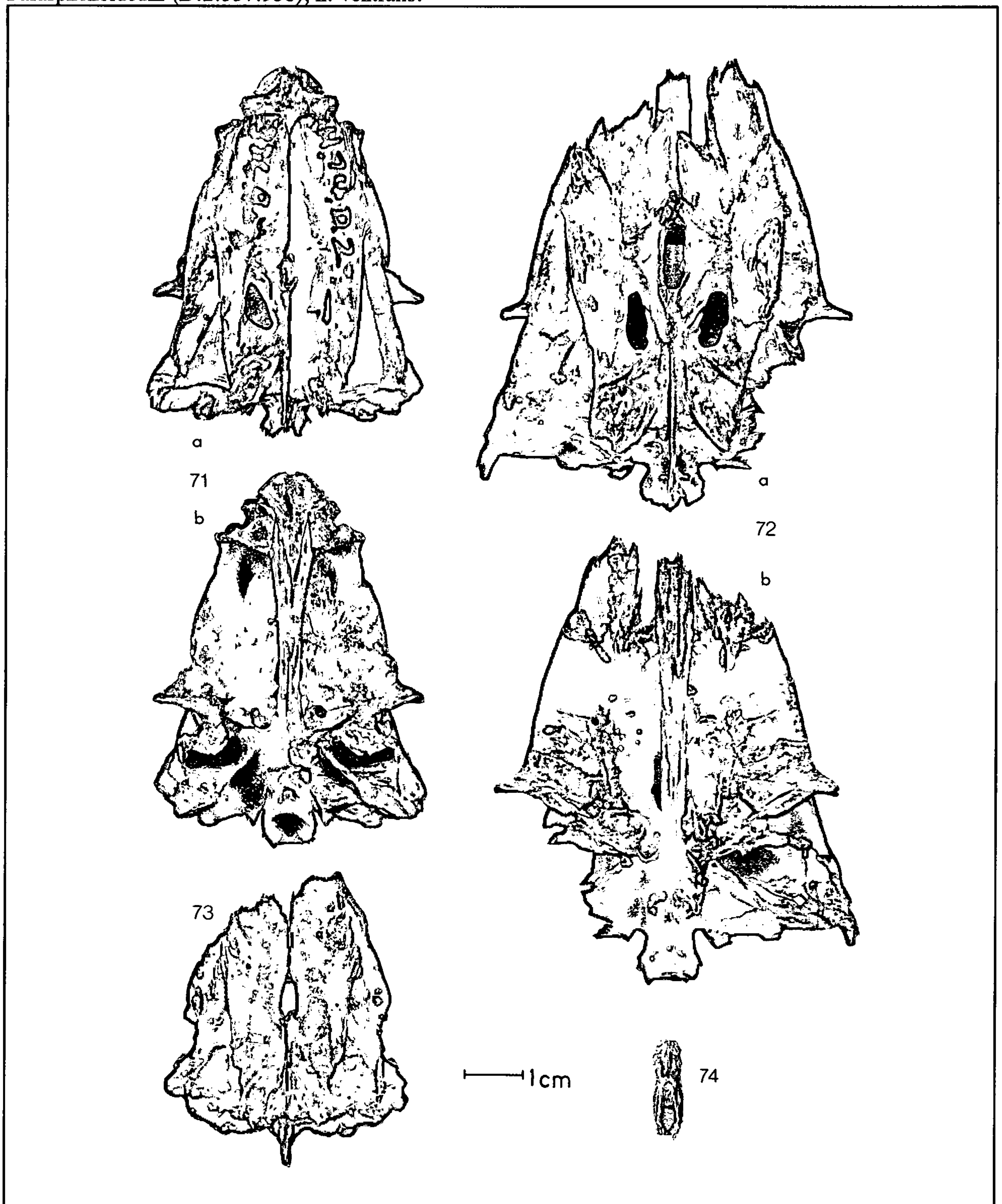
The average total length of the former species from Aqaba is given by these authors as 65 cm. Of the other, the total length has varied from 40.3 to 41.5 cm. The latter fish is, according to these authors, "a valuable and important food fish."

Dispersal of the Finds

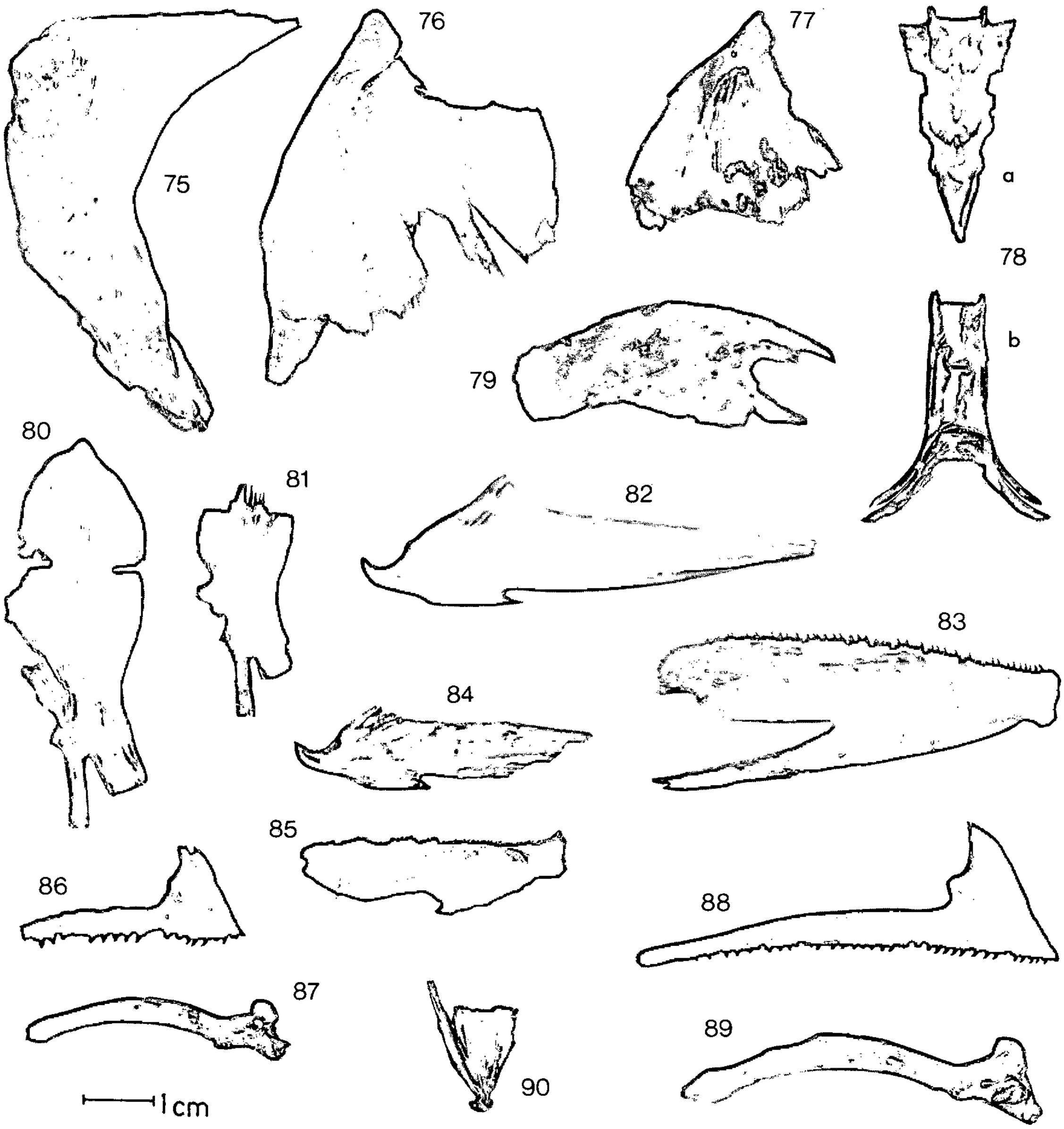
There is no direct evidence for a dispersal of an individual skeleton outside a single archaeological area. However, the scarcity of the finds outside Area D and the very strong concentration and abundance of them in this area awakes the suspicion that the occurrence of Scombrid remains outside Area D could be due to a secondary displacement. Remains of Scombrid fish are not known from Areas F or G, but they are strongly concentrated in Area D (especially to the Squares D.2 and D.4). If one reckons with a primary dispersal, the distribution of the bone units and the individuals is presented in table 9.48. Data on MNI is given in table 9.49.

The skeleton of scombrids is remarkably well represented within the finds. Only nasalia, circumorbitalia, ectopterygoidea, stylohyalia, branchialia, ultimate caudal vertebrae, hypuralia, ribs, postcleithralia, radialia, and basipterygia are lacking and/or have not been recognized with a sufficient certainty (table 9.50). Also represented are: 9 scleroticalia, 12 broken-off processus

Plates 9.71-9.74 Scombridae finds: **71)** *Euthynnus cf. affinis*, Neurocranium (D.2:376.95b), 71a) n. dorsalis, 71b) n. ventralis; **72)** *Euthynnus (Katsuwonus) pelamis*, Neurocranium (D.2:396.80b), 72a) n. dorsalis, 72b) n. ventralis; **73)** *Auzis thazard*, Neurocranium (D.2:337.95b), n. dorsalis; **74)** *Auxis thazard*, Parasphenoideum (D.2:337.95b), n. ventralis.



Plates 9.75-9.90 All Scombridae finds are *Euthynnus* sp.: **75)** *E. (Katsuwonus) pelamis*, Praeoperculare dext. (D.2:87.95c), n. lateralis; **76)** *E. (Katsuwonus) pelamis*, Operculare dext. (D.2:87.95c), n. medialis; **77)** *E. cf. affinis*, Operculare dext. (D.2:337.95b), n. medialis; **78)** *E.* sp., Vertebrae caudales post. (D.4:94), 78a) n. dorsalis, 78a) n. lateralis; **79)** *E. (Katsuwonus) pelamis*, Posttemporale dext. (D.2:87.95c), n. lateralis; **80)** *E. (Katsuwonus) pelamis*, Epi- + Keratohyale sin. (D.2:87.95c), n. lateralis; **81)** *E. cf. affinis*, Keratohyale sin. (D.4.69), n. lateralis; **82)** *E. (Katsuwonus) pelamis*, Articulare dext. (D.2:396.80b), n. lateralis; **83)** *E. (Katsuwonus) pelamis*, Dentale dext. (D.2:396.80b), n. lateralis; **84)** *E. cf. affinis*, Articulare dext. (undated), n. lateralis; **85)** *E. cf. affinis*, Dentale dext. (D.2:337.95b), n. lateralis; **86)** *E. cf. affinis*, Praemaxillare dext. (undated), n. lateralis; **87)** *E. cf. affinis*, Maxillare dext. (D.2:337.95b), n. lateralis; **88)** *E. (Katsuwonus) pelamis*, Praemaxillare dext. (D.2:396.80b), n. lateralis; **89)** *E. (Katsuwonus) pelamis*, Maxillare dext. (D.2:396.80b), n. lateralis; **90)** *E.* sp. Quadratum sin. (D.2:337.95b), n. medialis.



Plates 9.91-9.95 Scombridae finds: **91)** *Euthynnus (Katsuwonus) pelamis*, Hyomandibulare sin. (D.2:396.80b), n. lateralis; **92)** *Euthynnus cf. affinis*, Hyomandibulare sin. (D.2:337.95b), n. lateralis; **93)** *Auxis thazard*, Vertebrae praecaudales (D.4:98), n. lateralis sin.; **94)** *Euthynnus cf. affinis*, Vertebra caudalis ant. (D.2:95c), 94a) n. lateralis, 94b) n. cranialis; **95)** *Euthynnus (Katsuwonus) pelamis*, Vertebra caudalis (C.1:373.16), n. lateralis sin.

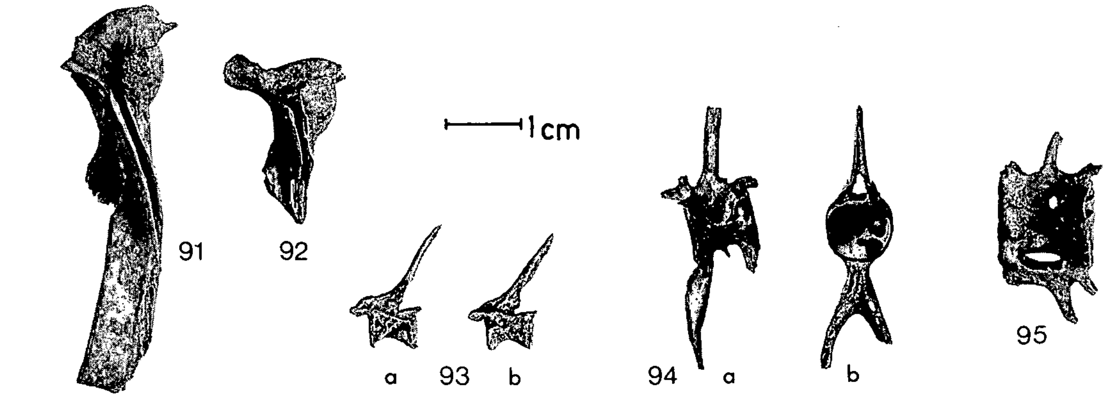


Table 9.47 Stratigraphic survey of the Scombridae finds.

Square Number	Total Length (*ca.* cm)	Anatomical Character & Code	Number of bones	Number of individual
A.9	60	Vertebra caudalis (8)	1	1
A.10	?	Processus spinosus (16)	1	1
B.7	60-70	Parasphenoideum (56.5 e), 1(1:0) articulare (56)	2	1
	?	2 processus spinosii (37)	2	-
C.1	60-70	Vertebra caudalis (373.16)	1	1
C.7	?	Acanthotrich (47: 2 fragments)	1	1
C.8	60-70	Vertebra caudalis (9), do. (E.26)	2	1
D.2	40-50	Neurocranium (376.95b), do. (do.: roof), 6 do. (do.: aboral parts), 8 do. (do.: otical parts), 2(1:1) frontalia (do.), 9 vomeres (do.), 10 parasphenoidea (do.), 5 do. (do.: oral fragments), 8(5:3) ectethmoidea (do.), 14(5:9) pterotica (do.), 14(7:7) sphenotica (do.), 21(12:9) epiotica (do.), 3(0:3) prootica (do.), 3 supra-occipitalia (do.), 8 basioccipitalia (do.), 14(9:5) exoccipitalia (do.), 14 (6.8) praemaxillaria (do.), 3(0:3) do. (do.: corpus-fragments), 24(13:11) maxillaria (do.), 6(4:2) palatina (do.), 21(10:11) hyomandibularia (do.), 10(4:6) quadrata (do.), 13(10:3) articularia (do.), 36 (21:15) dentalia (do.), 2(2:0) do. (do.: dorsal fragments), 5(1:4) epihyalia (do.), 20(11:19) keratohyalia (do.), 1(0:1) do. (do.: dorsal fragment), 11(8:3) hypohyalia (do.), 2 basihyalia (do.), 1 urohyale (87.95c), 4(1:3) praeopercularia (376.95b), 18(13:5) do. (do.: dorsal parts), 5(2:3) do. (do.: intermediate parts), 4(2:2) do. (do.: ventral parts), 17(5:12) opercularia (do.: mainly articular parts), 1(0:1) interoperculare (do.), 3 vertebrae praecaudales I (do.), 2 do. II (do.), 2 do. III (do.), 2 do. IV (do.), 6 vertebrae praecaudales (do.), vertebra caudalis ant. (95c), 3 do. (337.95b), 2 vertebrae caudales with lateral keels (do.), vertebra caudalis post. (do.), 1(1:0) posttemporale (87.95c), 5(2:3) do. (337.95b), 2(0:2) supracleithralia (do.), 1(1:0) cleithrum+scapula (do.: dorsal parts), 5(5:0) cleithra (do.), 1(0:1) scapula (do.)	382	21
	60-70	Neurocranium (396.80), parasphenoideum+occipitalia (87.95c), 2 scleroticalia (do.), 3 do. (396.80b), 1(0:1) ectethmoideum (87.95c), 1(1:0) pteroticum (337.95b), 3(2:1) praemaxillaria (396.80b), 4(2:2) maxillaria (do.), 1(0:1) do. (331.95), 2 endopterygoidea (396.80b), 1(0:1) hyomandibulare (do.), 2(1:1) articularia (87.95c), 2(1:1) do. (396.80b), 1(1:0) dentale (336.95b), 1(0:1) do. (87.95c), 3(1:2) do. (396.80b), 1(0:1) epi- + keratohyale (87.95c), 1(0:1) do. (396.80b), 2 urohyalia (87.95c), 2(1:1) praeopercularia (87.95c), 3(2:1) do. (396.80b), 1(1:0) operculare (87.95c), 5(4:1) do. (337.95b), 1(1:0) interoperculare (396.80b), vertebra praecaudalis I (87.95c), vertebra caudalis post. before the keeled ones (273.43), 2 do. (337.95b), 3 vertebrae caudales post. with lateral keels (337.95b), do. (34.95c)	53	4
	?	Pterygiophrous (337.95b), 2 acanthotrichi (do.), 14 lepidotrichi (337.95b: fragments), 1 caudal lepidotrich (do.), *ca.* 30 fragments (87.95c), *ca.* 58 fragments (337.95b), 4 fragments (396.80b)	3+107	-
D.3	60-70	1(0:1) cleithrum (138.48)	1	1
D.4	40-50	1(0:1) praemaxillare (69), 1(0:1) maxillare (do.), 1(0:1) palatinum (do.), 1(1:0) endopterygoideum (do.), 1(0:1) articulare (do.), 1(1:0) dentale (do.), 1(0:1) keratohyale (do.), 1(1:0) operculare (90), 1(0:1) do. (69), vertebra praecaudalis V (98), vertebra praecaudalis VI (do.), 1(1:0) cleithrum (207.69: dorsal part), 2(2:0) do. (do.: ventral parts), 1(0:1) cleithrum+scapula (do.)	13-15	2
	60-70	1(0:1) keratohyale (94), 1(1:0) praeoperculare (do.), 2 vertebrae caudales post. (do.)	4	1
	?	5 processus spinosii (69), 1 do. (88), 2 do. (94), 2 lepidotrichi (69), 2 caudal do. (94), acanthotrich (69: spina pinnae pectoralis), 12 fragments (69), fragment (102)	13+13	-
D.7	?	8 lepidotrichi (365.102: of finlets?), *ca.* 40 fragments of lepidotrichi (do.)	*ca.* 48	1
Undated	40-50	1(1:0) praemaxillare, 1(1:0) articulare, 2(1:1) praeopercularia, 1(1:0) interoperculare, 3 subopercularia	8	-
	60-70	Otical fragment, 2 scleroticalia, mesethmoideum+ectethmoidea, 1(1:0) praemaxillare, 1(0:1) palatinum, 1(1:0) metapterygoideum, 1(0:1) metapterygoideum+hyomandibulare, 1(0:1) dentale, 1(1:0) supracleithrale	10	-
	?	2 scleroticalia, 1 endopterygoideum, 1 neurarcus, 4 fragments of lepidotrichi, *ca.* 46 fragments	8+46	-

Table 9.48 Dispersal of the Scombridae finds.

Total Length (*ca.* cm)	Bones						Individuals				
	?	A	B	C	D	Sum	A	B	C	D	Sum
40-50	8	-	-	-	383-399	391-407	-	-	-	22	22
60-70	10	1	2	3	58	74	1	1	1	5	8
unknown	4	1	2	1	12	20	-	-	-	-	-
Sum	22	2	4	4	453-469	485-501	1	1	1	27	30

Table 9.49 Minimum number of Scombridae individuals (MNI).

The most abundant skeletal element on the same side	Size classes (*ca.* cm) 40-50	60-70	
Dentale dext.	22	-	
Operculare dext.	-	5	
MNI	22	5	Sum 27
MNI' = sum of MNI in different areas			Sum 30
MNI'/MNI 1.1			

spinosii (including 1 neurarcus-fragment), 1 pterygoiphore, 3 acanthotrichs and about 71 fragments of lepidotrichi.

Preservation

Contrary to the finds of other fish groups (except the small Sciaenids), the osseous substance of the Scombrid finds is remarkably porous and brittle. It seems to have lost a great deal of its organic matter. Usually the bones of tunnies are very fatty and may therefore be relatively quickly destroyed by their own fat acids in a case of taphonomical autolysis. Obviously, this has not been the case with the scombrid remains from Tell Hesban. As already mentioned, they have not been much decalcinated, but have, in contrast, lost their binding organic component. Perhaps they did not become rancid because these fish were treated with salt to preserve them during their long transport from the Red Sea to Tell Hesban. The fats may be absorbed by the soil from the remains without affecting the bone substance.

Another remarkable peculiarity of the Scombrid finds is that there are a lot of neurocranial parts preserved. These usually are much more seldom because the scavenging animals prefer to devour them, as they are fatty and contain brain remains. Perhaps this also is an indication that the remains of Scombrids have been salted and so made untasty for the scavengers. In contrast to the biologic destruction, these remains seem to have suffered more from mechanical destruction (trampling). The thinner parts are either lacking or crushed to small pieces. (There are more than 150 Scombrid fragments in the material which are not more exactly identifiable anatomically!) The most frequent skeletal elements (the relative loss less than 50%) are dentals, epiotics, praeoperculars,

Table 9.50 Scombridae: 1) Frequency, 2) Symmetry of the Sides, 3) Relative Representation, 4) Relative Loss.

Skeletal Elements	1	2	3	4
Unpaired (expected 27)				
Parasphenoideum	19	-	70.4%	29.6%
Basioccipitale	16	-	59.3%	40.7%
Supraoccipitale	12	-	44.4%	55.6%
Vomer	10	-	37.0%	63.0%
Basihyale	3	-	11.1%	88.9%
Urohyale	3	-	11.1%	88.9%
Mesethmoideum	1	-	-	-
Paired (expected 54)				
Dentalia	44	23+2:19	81.5%	18.5%
Epiotica	42	22:20	77.8%	22.2%
Praeopercularia	39	21+2:14+2	72.2%	27.8%
Pterotica	36	13:23	66.7%	33.3%
Exoccipitalia	32	17:15	59.2%	40.8%
Maxillaria	30	15:15	55.5%	44.5%
Sphenotica	26	13:13	48.1%	51.9%
Opisthotica	25	9:16	46.3%	53.7%
Keratohyalia	25	11:13+1	46.3%	53.7%
Opercularia	25	11:14	46.3%	53.7%
Praemaxillaria	23	10:10+3	42.6%	57.4%
Hyomandibularia	23	10:13	42.6%	57.4%
Articularia	21	15:6	38.9%	61.1%
Frontalia	12	6:6	22.2%	77.8%
Ectethmoidea	12	7:5	22.2%	77.8%
Hypohyalia	11	8:3	20.4%	79.6%
Cleithra	11	7+2:1+1	20.4%	79.6%
Parietalia	10	5:5	18.5%	81.5%
Quadrata	10	4:6	18.5%	81.5%
Palatina	8	4:4	14.8%	85.2%
Prootica	7	2:5	13.0%	87.0%
Epihyalia	7	1:6	13.0%	87.0%
Posttemporalia	6	3:3	11.1%	88.9%
Endopterygoidea	4	-	7.4%	92.6%
Interopercularia	4	2:2	7.4%	92.6%
Subopercularia	3	-	5.5%	94.5%
Supracleithralia	3	1:2	5.5%	94.5%
Metapterygoidea	2	1:1	3.7%	96.3%
Angularia	2	1:1	3.7%	96.3%
Scapulae	2	1:1	3.7%	96.3%
Serial				
Vertebrae praecaudales (expected 9x27=216)	18	-	8.3%	91.7%
Vertebrae caudales (expected (30x27=810)	21	-	2.6%	97.4%

Table 9.51 Scombridae measurements.

Bone
Locus Number — Measures (in mm)

Neurocranium

	D.2:376.95b Smaller form	D.2:396.80b Larger form
Length	63.2	77+
Length: Frontale-Epioticum	48	64.5
Mesethmoidal width	16.1	-
Ectethmoidal width	25.2	-
Vomerine width	11.1	-
Maximal frontal width	35.7	47.5
Sphenotic width	46	58.9
Pterotic width	47(+)	-
Epiotic width	19.5	24.3(+)
Width between the lateral points of opisthotical protuberances	28.2	-
Width of the exoccipital articulations	9	11.2
Horizontal diameter of basiooccipital articulation	7	7.8
Length of vomer	(20.8)	-
Length of parasphenoideum (visible part)	55	73(+)
Maximum width of the oral part of parasphenoideum	7	6.5
Parasphenoidal constriction	3.1	3.1
Maximum width of parasphenoideum lateral to the myodome opening	9.1	9.2
Height of the myodome opening	6.9	7.3
Maximal height of the neurocranium	32(+)	43.8

	Pterotic Width	Epiotic Width	Width of opisthootical protuberances	Form
D.2:337.95b	-	12.5	-	S.f.
D.2:337.95b	50	-	29.3	(*Auxis*)
D.2:337.95b	-	16	-	S.f.
D.2:337.95b	49	17	30.5	S.f.
Undated	-	24.5	-	L.f.

Praemaxillare

	Side	Length	Length Diameter of symphysis	Form
D 4.69	sin.	-	14.5	S.f.
D.2:337.95b	sin.	-	14.7	S.f.
D.2:337.95b	sin.	-	15.2	S.f.
Undated	dext.	-	15.8	S.f.
D.2:337.95b	dext.	-	16.2	S.f.
D.2:396.80b	dext.	56	22	L.f.
D.2:396.80b	dext.	58.3	24	L.f.

Maxillare

	Side	Length	Diagonal Height of articular part	Form
D.2:337.95b	sin.	29.7	8.7	S.f.
D.2:337.95b	sin.	34	9.5	S.f.
D.2:337.95b	dext.	35	10.1	S.f.
D.2:337.95b	dext.	37	9.4	S.f.
D.2:331.95	sin.	48	13	L.f.
D.2:396.80b	dext.	51	13.2	L.f.
D.2:396.80b	sin.	51	13.3	L.f.
D.2:396.80b	sin.	51	14	L.f.

Hyomandibulare

	Side	Length	Distance between articular surfaces of proc. sphenoticus and proc. opercularis	Form
D.2:337.95b	dext.	21.5	16.1	S.f.
D.2:337.95b	sin.	18.5+	15	S.f.
D.2:337.95b	sin.	18+	15.3	S.f.
D.2:337.95b	sin.	35	14	S.f.
D.2:396.80b	sin.	50	-	L.f.

Quadratum

	Side	Height	Width of the articular process	Form
D.2:337.95b	sin.	-	3.6	S.f.
D.2:337.95b	dext.	-	3.7	S.f.
D.2:337.95b	dext.	-	3.8	S.f.
D.2:337.95b	sin.	-	3.8	S.f.
D.2:337.95b	dext.	-	4	S.f.
D.2:337.95b	sin.	-	4	S.f.
D.2:337.95b	sin.	-	4	S.f.
D.2:337.95b	dext.	-	4.2	S.f.
D.2:337.95b	sin.	20.1	4.2	S.f.
D.2:337.95b	sin.	23	4.2	S.f.

Articulare

	Side	Length	Articular surface to processus postarticularis	Form
D.2:337.95b	dext.	-	6.4	S.f.
D.2:337.95b	dext.	-	6.5	S.f.
D.2:337.95b	dext.	-	6.5	S.f.
D.2:337.95b	sin.	-	6.5	S.f.
D.2:337.95b	sin.	-	6.5	S.f.
D.2:337.95b	sin.	-	6.9	S.f.
Undated	dext.	42.5	-	S.f.
D.2:396.80b	dext.	68(+)	7.6	L.f.
D.2:396.80b	dext.	61	8	L.f.

Dentale

	Side	Length	Symphyseal height	Form
D.2:337.95b	dext.	-	4.5	S.f.
D.2:337.95b	sin.	-	5.6	S.f.
D.2:337.95b	dext.	-	6	S.f.
D.2:337.95b	dext.	-	6	S.f.
D.2:337.95b	sin.	-	6.1	S.f.
D.2:337.95b	dext.	-	6.2	S.f.
D.2:337.95b	dext.	-	6.3	S.f.
D.2:337.95b	dext.	-	6.3	S.f.
D.2:337.95b	dext.	-	6.3	S.f.
D.2:337.95b	dext.	33.5	6.4	S.f.
D.2:337.95b	dext.	-	6.5	S.f.
D.2:337.95b	dext.	-	6.5	S.f.
D.2:337.95b	dext.	-	6.5	S.f.
D.2:337.95b	dext.	-	6.7	S.f.
D.2:337.95b	dext.	-	6.8	S.f.
D.2:337.95b	sin.	-	6.8	S.f.
D.2:337.95b	sin.	-	6.8	S.f.
D.2:337.95b	sin.	-	6.9	S.f.
D.2:337.95b	dext.	-	7	S.f.
D.2:337.95b	sin.	-	7	S.f.
D.2:337.95b	sin.	-	7	S.f.
D.2:337.95b	sin.	-	7	S.f.
D.2:337.95b	dext.	-	7.1	S.f.
D.2:337.95b	dext.	-	7.1	S.f.
D.2:337.95b	sin.	-	7.1	S.f.
D.2:337.95b	sin.	-	7.2	S.f.
D.2:337.95b	sin.	-	7.2	S.f.
D.2:337.95b	sin.	-	7.3	S.f.
D.2:337.95b	sin.	-	7.3	S.f.
D.2:337.95b	sin.	-	7.4	S.f.
D.2:337.95b	dext.	-	7.5	L.f.?
D.2:337.95b	dext.	-	7.5	S.f.
D.2:337.95b	dext.	-	7.5	S.f.
Undated	sin.	54.5	8	L.f.
D.2:87.95c	sin.	54(+)	8.1	L.f.
D.2:396.80b	sin.	56	8.2	L.f.
D.2:396.80b	sin.	57.5	8.3	L.f.
D.2:396.80b	dext.	58.2	8.4	L.f.

Os hyoideum

	Side	Height of Epihyale	Height of Keratohyale oral	Height of Keratohyale aboral	Form
D.4:69	sin.	-	23.2	29.5	S.f.
D.2:337.95b	sin.	-	-	32.5	S.f.
D.2:337.95b	dext.	-	(28)	33	S.f.
D.2:87.95c	sin.	20	32.5	38	L.f.
D.2:396.80b	dext.	20.1	-	41	L.f.

Basihyale

	Length	Width	Form
D.2:337.95b	12.6	-	S.f.
D.2:337.95b	14.3	8.1	L.f.

Urohyale

	Length	Height	Form
D.2:87.95c	-	15.2	S.f.
D.2:87.95c	42.5	13.4	L.f.
D.2:87.95c	48	13.7	L.f.

Praeoperculare

	Side	Chordal length	Form
D.2:396.80b	dext.	57	L.f.
D.4:226.94	dext.	58	L.f.
D.2:87.95c	dext.	59.5	L.f.
D.2:396.80b	dext.	62.2(+)	L.f.
D.2:396.80b	sin.	64	L.f.

Operculare

	Side	Fossa articularis + processus supraarticularis	Form
D.4:90	dext.	8	S.f.
D.2:337.95b	sin.	8(+)	S.f.
D.2:337.95b	dext.	9.1(+)	S.f.
D.2:337.95b	sin.	9.2	S.f.
D.2:337.95b	sin.	9.2	S.f.
D.2:337.95b	dext.	9.5	S.f.
D.2:337.95b	sin.	9.2(+)	S.f.
D.2:337.95b	dext.	9.8	S.f.
D.2:337.95b	dext.	9.8	S.f.
D.2:337.95b	sin.	9.8	S.f.
D.2:337.95b	sin.	9.8	S.f.
D.2:337.95b	dext.	10	S.f.

Table 9.51, *continued.* Scombridae measurements.

Bone Locus Number		Measures (in mm)			
Operculare (continued)	Side	Fossa articularis+processus supraarticularis			Form
D.2:337.95b	sin.	10.9			L.f.
D.2:337.95b	dext.	11			L.f.
D.2:87.95c	dext.	11			L.f.
D.2:337.95b	dext.	11			L.f.
D.2:337.95b	dext.	11			L.f.
D.2:337.95b	dext.	11.2			L.f.
Posttemporale	Side	Dorsal Length	Ventral Length		Form
D.2:87.95c	dext.	47.5	42.5		S.f.
Vertebrae praecaudales	Side	Medioventral length of corpus vert.	Diameters (hor. × vert.) of contact surfaces of corpus vert. cranial	caudal	Form
D.2:337.95b	I	5.1	6.5×6.8	7×7.8	S.f.
D.2:87.95c	I	7.2	7×7.1	10×9.2	L.f.
D.2:337.95b	I	4.6	5×5.2	(7.1×6.8)	S.f.
D.2:337.95b	II	7	7.1×6.8	7.6×7.1	S.f.
D.2:337.95b	III	6.9	7×6.9	7.5×7	S.f.
D.2:337.95b	IV	7	7.3×6.9	7.8×6.1	S.f.
D.2:337.95b	I	5.5	6.5×7.3	7.5×7.8	S.f.
D.2:337.95b	II	6.5	6.9×7.2	8×7.2	S.f.
D.2:337.95b	III	7	8.5×6.4	7.5×7.3	S.f.
D.2:337.95b	IV	8	7.8×6.9	8.2×7.1	S.f.
D.2:337.95b	-	6.5	7.7×(6)	8.3×6.1	S.f.
D.2:337.95b	-	6.5	7.9×6.1	7.5×6	S.f.
D.2:337.95b	-	6.8	8×6	7.8×6.1	S.f.
D.2:337.95b	-	6.8	8×6.1	7.9×6	S.f.
D.2:337.95b	-	7.3	7.8×6.2	7.9×6.9	S.f.
D.4:98	V	5.8	5×4.5	5×4.5	*Auxis*
D.4:98	VI	6	4.6 × 4.5	5×5	*Auxis*
Vertebra caudalis	Side	Lateral Length	Diameters (hor. × vert.) of contact surfaces of corpus vert. cranial	caudal	Form
D.2:337.95b	-	8.5	8.5×7.3	8.8×7.8	S.f.
D.2:95c	-	8.5	8.8×7.5	9×8.1	S.f.
D.2:337.95b	-	9.2	8×8	8×9	S.f.
C.8:9	-	10	9.8×9.6	10.4×10	L.f.
C.1.373.16	(XX)	12.1	10.5×10.9	10.5×10.9	L.f.
C.1:373.16	(XX)	11.4	(12.8)×10	12×10.5	L.f.
C.8:26	-	12.3	(10)×11	11.1×9.7	L.f.
D.2:273.43	-	10.3	9.3×9.3	9.8×9.3	L.f.
D.2:337.95b	-	9.7	7.7×9.3	8.8×7.4	L.f.
D.2:337.95b	-	10	8×7.4	8.1×7.5	L.f.
D.2:34.95c	last keeled	7.3	8.1×6.1	6.7×6.7	L.f.
D.4:94	keeled	8.9	-	-	L.f.
D.4:94	keeled	8	-	-	-
D.4:94	-	4	-	-	-
D.2:337.95b	keeled	12	9.7×(8)	8.5×6.4	L.f.
D.2:337.95b	keeled	9.6	8×6.3	6.8×5.2	L.f.
D.2:337.95b	keeled	9	8.6×6.3	7×5.5	L.f.
D.2:337.95b	post-keeled	6.5	6.3×5.2	-	S.f. or *Auxis* ?
D.2:337.95b	post-keeled	6	6.7×5.2	-	S.f. or *Auxis* ?
D.2:337.95b	post-keeled	2.5	-	-	S.f. or *Auxis* ?

basioccipitals, pterotics, exoocipitals, and maxillars. All these have a form and structure very resistant to mechanical forces. They either have thickened parts (as symphysis of the dentals), strengthening of the criss-cross ridges, or deep articulation surfaces. Measurements are provided in table 9.51.

Zoogeographical Remarks

The frigate mackerel, *Auxis thazard*, is a cosmopolitic marine fish of subtropical and tropical seas. It occurs even in the Mediterranean. The oceanic bonito, *Katsuwonus pelamis*, has a similar distribution to the previous species. *Euthynnus affinis* is known from the Red Sea and the Indian Ocean.

Ecological Remarks

All three species named above are halo- and thermophilous pelagic fish of surface waters, where they prey on smaller shoal fish. They are self gregarious and very migratory.

Economical Remarks

The fatty and nutrient meat of the tunnies and their allies has been much valued since the antiquity. Their occurrence in surface waters in large swarms and their large size make them objects of a very profitable fishery with nets, tonnaries, angling, and whiffing.

Occurrence at Tell Hesban

The relatively high symmetry of the find numbers on both sides of the body and the practically non-existent differences between MNI and MNI[1] seem to indicate a low degree of loss in the Scombrid remains from Tell Hesban (see table 9.49). Because of this, they may be somewhat over-represented in relation to the finds of other fish groups.

The great concentration of the Scombrids in Area D (especially in Squares D.2 and D.4) is very remarkable, as is the abundance of them especially in Locus D.2:337.95b. The relatively few finds of the frigate mackerel and some of the oceanic bonito may come from the Mediterranean. However, the dominating finds of the (probable) *Euthynnus affinis*, a Red Sea species, stress the significance of import from Red Sea. Perhaps even the frigate mackerels and the oceanic bonitos were taken together with *Euthynnus affinis*. This long transport from the Gulf of Aqaba to Tell Hesban (about 260 km, the distance to the Mediterranean coast at Jaffa is only *ca.* 110 km) in a hot climate may have made the preservation of these big fatty fish by salting necessary.

The remains found in the excavation material may represent originally *ca.* 30-40 fish. Because the finds of the postcranial skeleton are so few, the remains probably mainly derive from the heads cut off from the meaty bodies and thrown at the refuse heap.

Unidentified Fish Remains

A number of remains found at Tell Hesban were

Table 9.52 Unidentified fish remains from Tell Hesban.

Locus Number	Anatomical Character	Maximum Diameter (in mm)
A.7:42	Pterygiophorus	30
A.7:132.61	Fragment (quadratum?)	24.5+
A.10:16	Fragment (posttemporale?)	31+
C.1:923.121	Fragment	23+
C.5:84	Hypurale	29+
C.5:93	Circumorbitale ?	23.5
C.5:93	Lepidotrich	37.2+
C.5:93	Caudal lepidotrich	32.6+
C.5:98	Fragment	31.2+
C.5:149	Caudal lepidotrich	28.3+
C.5:?15	Acanthotrich	25+
C.6:24	Pterygiophorus	26+
C.6:28.16	Acanthotrich	39+
C.6:34	Acanthotrich	36.5+
C.6:43	Praeoperculare ?	33+
C 6:54	Praeoperculare ?	35+
C.6:54	Hypurale ?	30.2+
C.7:62	Pterygiophorus	26.2+
C.8:11	Pterygiophorus	17.5+
C.8:17	Lepidotrich	36+
C.8:18	Lepidotrich	32.3+
C.8:23	Lepidotrich	41.5+
C.8:34	Costa	53.6+
C.8:43	Ectopterygoideum ?	25
C.10:115.3?	Fragment	23+
D.1:176.22	Fragment	33.5
D.2:87.95c	Fragment	23.5+
D.2:337.95b	?	13
D.2:337.95b	?	14
D.2:337.95b	?	15.4
D.2:337.95b	?	16
D.2:337.95b	?	18
D.2:337.95b	Branchiale ?	10.2
D.2:337.95b	Branchiale ?	10.8
D.2:337.95b	Fragment	18+
D.2:337.95b	Fragment	19+
D.3:169.?9	Cleithrum ?	29+
D.4:14.1	Caudal lepidotrich	30+
D.4:1?	Fragment	31.5+
D.4:210.6?	Acanthotrich	32+
D.4:219.92	Cleithrum dext. (Scombridae ?)	45.6+
Undated	Fragment	12+
Undated	Fragment	14.3+
Undated	Hypurale	19
Undated	Hypurale	27.5
Undated	Pterygiophorus	20.2+
Undated	Acanthotrich	34.5+
G.4:41	Costa	42.8
Sum		48 finds, including: 5 pterygiophores, 5 acanthotrichs, 7 lepidotrichs, 4 hypurals, 2 costae, 2 branchials, 23 anatomically not identified fragments or bones.

not identified. Stratigraphic data for these are found in table 9.52.

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Chapter Ten

INTERPRETIVE CONCLUSIONS

Øystein Sakala LaBianca

Chapter Ten

Interpretive Conclusions

Introduction

We have seen presented in the foregoing chapters the results of several different, but interrelated, studies of the more than 100,000 animal remains from Tell Hesban and vicinity. While the first four chapters described by whom, wherefore, and by what means the bones were collected and studied—as well as studies of how and why they became a part of the archaeological record of Tell Hesban in the first place—chapters 5-9 examined the bones in terms of what they could tell us about the development and distribution of the various species represented in the finds and their respective contributions to the way of life of the inhabitants of ancient Hesban throughout its history.

Given the concern introduced in the first volume of this final publication series with reconstructing cycles of intensification and abatement in the food system of Hesban, what light, if any, do the various studies presented in the present volume cast on this broader question? In these concluding remarks, my goal is to highlight several important ways in which this question has been illuminated by the research presented here.

The Predominance of Sheep and Goats

To begin with, I think the statistics presented in chapters 2 and 5 regarding the relative importance of different species of animals in the daily lives of people at Hesban add empirical weight to the original hunch which launched the zooarchaeological work on this project in the first place—namely the hunch that the breeding and caring for sheep and goats have been the single most important daily activities involving animals at Hesban throughout all periods of human occupation of the site. Thus, in terms of numbers owned, in terms of time and effort devoted to animal husbandry, and in terms of contribution to the daily diet, pastoral production of sheep and goats stands out above all other activities involving domestic animals as being number one.

This finding, as might be expected, brings to mind several important questions. Why were sheep and goats so central to peoples lives? What about the contribution of other domestic animals to the local economy of Tell Hesban throughout the past? And how do the remains of various wild mammals, birds, reptiles, amphibians and fishes fit into the picture as far as Hesban's food system is concerned? To what extent has the local environment been altered as a result of human exploitation of animals and plants? While the answers to some of these questions have already been alluded to in certain of the previous chapters, in what follows they will be considered more explicitly.

First, why were sheep and goats so central to people's lives at Tell Hesban? To answer this question we must begin by examining the phenomena of mixed agro-pastoral dry farming and subsistence pastoralism as traditional strategies for producing food in the Middle East.

Mixed Agro-pastoral Dry Farming

Mixed agro-pastoral dry farming is typically found in the semiarid plains and highlands of the Middle East, where usually, but not always, it is associated with people living year-round in villages and towns (Kates, *et al.* 1977: 271, 272). At the most basic level it involves raising of field crops such as wheat, barley, and lentils on the arable plains and production of sheep and goats on the stubble fields and on nearby mountain slopes and desert pastures. Farmers may further diversify their production by raising garden crops and sometimes also fruit trees. As a means to produce food in the Middle East, mixed agro-pastoral dry farming is very ancient, having emerged early during the Pre-pottery Neolithic when the first farming villages came into existence in the region.

Subsistence pastoralism, which involves mobile production of herd animals such as sheep, goats, cattle and camels, is believed to have evolved as a type of specialized production strategy sometime after the rise of village based agro-pastoralism. Recent research in Jordan suggests that it was the expansion of crop cultivation during the Pre-pottery Neolithic C that pushed prehistoric agriculturalists into experimenting with migratory herding of animals away from arable areas (Kohler-Rollefson 1992; Garrard, *et al.* 1988). The emergence during the Early Bronze Age of the first cities appears to have provided added impetus to specialized production of sheep and goats as expanding urban populations needed to be supplied with meat, milk, fiber, skins and wool (Horwitz and Tchernov 1989).

Given the location of Hesban in a geographical region which is ideally suited to mixed agro-pastoral dry farming, the occurrence of sheep and goat bones in larger quantities than any other species is not surprising. What can profitably be pondered further, however, is why their occurrence rates vary over time to the extent that they do relative to other species. What can the shifts over time in the proportional representation of sheep, goat, cattle, donkeys, horses, pigs, and camels tell us, on the one hand, about the ascendance of subsistence pastoralism during certain periods and, on the other hand, about the emergence of urban oriented food production during others?

Cycles of Sedentarization and Nomadization

To answer this question, we must begin by highlighting three factors which have profoundly impacted the cultural landscape of Hesban and vicinity since prehistoric times. These include the water situation in the region, the site's proximity to the Arabian desert, and its position along one of antiquities most important trade and communication corridors.

First, with regard to the availability of water. Common to the whole Eastern Mediterranean region is a season of the year when it rains and a season when there is little or no rain, only dew. Around Hesban the rainy season normally begins in November and usually ends in March or April. Traditionally rainfall has been counted on by villagers here not only to irrigate agricultural fields, but also to replenish cisterns and reservoirs above the ground and natural reservoirs and aquifers under the ground. An important advantage of subsistence pastoralism in this regard is that it is not reliant to the same degree on such permanent water collection facilities. Instead, pastoralists have traditionally relied on their mobility and knowledge of natural pastures and watering places for year-round access to these necessities.

The second factor is the proximity of Hesban and vicinity to the Arabian desert, which borders the eastern frontier of the whole of the Levant from Jordan in the south to Syria in the north. During the rainy season, this vast desert—which in most places is too dry for people to cultivate—produces pastures of sufficient quantity and quality to feed hundreds of thousands of animals. Consequently, it has for millennia attracted shepherds from settled areas such as Hesban, which have been eager to find fresh and open pastures on which to graze their flocks of sheep and goats. During the summer months, when the desert becomes too hot and dry, these shepherds would return with their flocks to graze them on the stubble fields which remain following the grain harvest in the well-watered areas surrounding their home villages and towns.

A third factor is the location of the Hesban region in a landscape which for millennia has served as an important natural land-bridge connecting Egypt and the African continent to the south with Mesopotamia and the Indian sub-continent to the east and Anatolia and the European continent to the northwest. A consequence of being located along such an important trade and communication corridor is that the local inhabitants of the region have had to cope with constantly shifting political and economic winds as a succession of external world powers to the west, south, and east have vied for control over the region.

Because of this situation, the political conditions necessary for sedentary agriculture to thrive have varied greatly over time. During certain periods when the threat to sedentary livelihoods became too great, village farmers were forced to either relocate to safer areas or to take up subsistence pastoralism. When conditions became more favorable again, they, or their descendants, have subsequently returned to their more settled ways. During certain periods, when urban interests were ascending in the region, very intensive food production practices came into existence. The long-term outcome of these occurrences are the cycles of food system intensification and abatement—and the related cycles of sedentarization and nomadization—which have been described in greater detail in the first volume in this final publication series.

Zooarchaeological Correlates of Cycles

To what extent, then, are these cyclic changes reflected in the bone finds from Tell Hesban? What clues do they provide as to the nature of mixed agro-pastoral farming at the site? And equally important, to what extent do they shed light on the ascendancy during certain historical periods of subsistence pastoralism, on the one hand, and urban-oriented farming on the other?

With respect to the nature of mixed agro-pastoral farming at Tell Hesban it appears always to have involved not only substantial numbers of sheep and goats, but also cattle. During Iron, Hellenistic/Roman and Ayyubid/Mamluk times, these species together accounted for at least 87% of the domestic animals remains, estimating on the basis of bone counts. Only during Byzantine times do their combined contribution drop to 80%. This drop coincides with a rise in importance of "barnyard animals" such as swine and chicken during this period.

This increase in barnyard animals during Byzantine times, along with a substantial increase also in the utilization of horse and donkey during this period, is consistent with a range of other archaeological evidences pointing to the dominance of urban-oriented farming at Tell Hesban during Byzantine times (LaBianca 1990). In other words, as more and more land was put to the plow, the need for traction and transportation animals increased. So did the demand for meat and by-products from barnyard animals which could feed on the refuse produced by intensive cultivation of garden, field and tree crops.

The increase in production of pigs and chickens during Byzantine times was not merely a matter of necessity, however, for pigs, and to a lesser degree, chickens, were both considered by Classical period medical experts (for example Galenos, A.D. 129-199) to have been the best and most healthful of foods. This is why throughout the whole Byzantine world, pigs are especially well represented among archaeological bone finds, even in very dry regions like Hesban, where pig keeping is not otherwise favored.

That this ascendence of urban-oriented farming, with its emphasis on production of food for export and trade, likely began during the earlier Hellenistic/Roman period is suggested by the fish finds. These point to extensive import of sea fish, especially tunny and meager. While there is not much else in the bone data to support this suggestion, it is a trend which is corroborated by other lines of historical and archaeological evidence from the region of Hesban (LaBianca 1990).

Two other periods during which the local food system reached intensification peaks of sorts were during the previous Iron II period and the subsequent Ayyubid-Mamluk period. These peaks are attested primarily by the fact that they produced proportionally larger quantities of bone finds when compared to immediately preceding and following periods (table 5.9). The Ayyubid-Mamluk peak is noticeable also because of the large quantity of chicken consumed during it and because of its characteristic exploitation of humped-back or zebu cattle. It should be emphasized, however, that neither of these two intensification peaks approached the level of urban-oriented production of food that was achieved during the Byzantine period.

Much less readily discernable in the bone data from Tell Hesban are the times when mixed agro-pastoral pursuits gave way to subsistence pastoralism by transhumant bedouin tribes. An obvious reason for this is, of course, that during those periods, sites such as Tell Hesban were at best used as seasonal camping places—and that by just a few families as opposed to the large number of households which contributed to the build-up of animal bone residue during more settled periods. The only clues we do have—as far as the animal bones are concerned—are the directional trajectories implicit in the bone data. These are the trends toward increases in the relative importance of sheep and goats during the periods which immediately precede and follow times when nomadic lifestyles were in ascendance, for example Strata 4 and 5. Elsewhere (LaBianca 1990) other lines of evidence are mobilized to fill in the picture during these periods of low intensity food production.

The paucity of direct evidence from these low intensity periods at Tell Hesban is attributable to the fact that when the site was excavated, investigation of these periods was not an explicit objective of the expedition. One of the reasons, however, for mounting the regional survey and associated hinterland excavation probes in connection with the Madaba Plains Project—which grew out of the Heshbon Expedition—was to fill in this gap.

Food System Cycles and the Natural Environment

When it comes to the question of the extent to which the natural landscape has been impacted by these multi-millennial cycles of food system intensification and abatement, the bone evidence is rather compelling. Thus, where 3,000 years ago forested hills and mountains provided shelter for the wild boar, wolf and leopard, today there remains sparsely covered hills and denuded mountains overrun by lizards and flocks of sheep and goats; and where open plains once provided pastures for large herds of dorcas gazelle, Nubian ibex and wild sheep and goats, today intensively cultivated orchards, gardens and cereal fields prevail. Such is the contrast when the faunal data from the present is compared with that from the distant past. But what about the intervening processes which produced this transformation. Four proposals as to how this occurred are offered as a framework for thinking about the data presented herein and as a stimulus to future research.

First, it is posited that the conversion of forested areas and grasslands into agricultural fields and grazing lands would have accelerated especially during times when the food system was being aggressively "pumped up." In other words, it happened at a particularly rapid rate during Roman-Byzantine times; and to a lesser extent, during Iron II and Ayyubid-Mamluk times.

Second, it is posited that when such power drives abated, a period of adjustment followed during which new ecological balances were established. Thus, in the wake of each intensification peak, species whose livelihoods were in direct competition with the human food system—in particular grassland feeders such as the dorcas gazelle and Nubian ibex, along with their predators, the lion and the leopard—experienced marked decreases in their numbers. Their gradual disappearance, in turn, led to improved opportunities for other species more adapt to surviving on the periphery of human settlements, such as the wolf and the hyena.

Third, it is posited that an increase in the number of rodents and birds which feed on cereals, garden produce, and fruit trees would have accompanied each power drive. With these "civilization followers," came, no doubt, increased numbers of their predators as well. Which precise species were present at any given point in time is, of course, a question which must await future zooarchaeological research in the region.

Fourth, it is posited that as environmental conditions became less favorable, certain species disappeared completely from the local ecosystem. In their place, others would likely have stepped in. The present-day wild fauna of Hesban and vicinity represents the latest stage in this succession of ecological transformations.

Note

I would like to express my appreciation to Dr. A. von den Driesch for pointing out the role of Galenos.

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